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RESOURCES

of THE HEADWATER COUNTIES

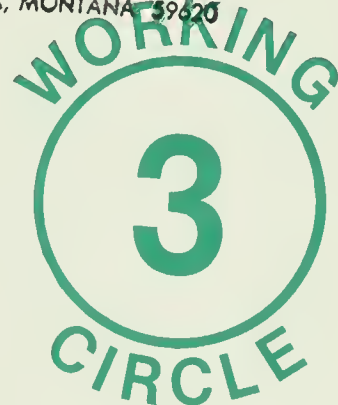


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TIMBER RESOURCES of THE HEADWATER COUNTIES

**LEWIS AND CLARK, POWELL, GRANITE,
DEER LODGE, BEAVERHEAD, SILVER BOW,
MADISON, JEFFERSON, BROADWATER
COUNTIES**

JANUARY, 1984

**MONTANA DEPARTMENT OF
STATE LANDS
FORESTRY DIVISION
2705 SPURGIN ROAD
MISSOULA, MONTANA 59801**

and

**FOREST SURVEY
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
REGION 1, USDA FOREST SERVICE**

ABSTRACT

Timber inventory data collected in 1978 for the 1.2 million acres of state and private commercial timberlands in Working Circle 3 estimated a total growing stock volume of 1.7 billion net cubic feet. Sawtimber volume was estimated to be 4.7 billion net board feet Scribner. Approximately 906,500 acres of grazable commercial timberland, of which 729,800 acres are in good or excellent condition, existed on state and private lands within the working circle. In 1978 the carrying capacity of this acreage was estimated to be 127,900 animal unit months.

The average potential productivity was found to be 54 cubic feet per acre per year. About 54 percent of the timberland had the potential to produce 50 or more cubic feet of wood per acre per year. Forty percent of the commercial timberland sampled was rated as excellent or good for timber production.

A large amount of the privately owned commercial forest is at a formative stage and can be manipulated to greatly increase future timber production. Silvicultural treatment opportunities existed on 60 percent of the commercial timberland sampled. These silvicultural treatments could dramatically increase the growth rates and thereby increase future timber supplies from state and private timberlands. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.

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PREFACE

This publication summarizes the findings of a timber resource inventory conducted in Beaverhead, Broadwater, Deer Lodge, Granite, Jefferson, Lewis and Clark, Madison, Powell, and Silver Bow Counties (Working Circle 3). It is the fourth in a series of forest inventory reports. Each report displays and analyzes inventory data for a different portion of the state. A statewide report will subsequently be published by the Intermountain Forest and Range Experiment Station in cooperation with the Montana Department of State Lands (DSL), Forestry Division.

The inventory of Working Circle 3 began in November, 1977, under the authority of an existing cooperative agreement between the Intermountain Forest and Range Experiment Station, Region 1 of the USDA Forest Service, and the Montana Department of Natural Resources and Conservation, Forestry Division. Under the agreement, the Forestry Division, transferred to the Department of State Lands in 1981, would supervise the collection of forest inventory data on all lands in Working Circle 3 except those administered by the USDA Forest Service or the USDI Bureau of Land Management. The USDA Forest Service would provide technical assistance and 60 percent of the funding for the project. The state of Montana would provide the remaining 40 percent.

Aerial photo interpretation began in December, 1977, and was concluded in June of 1978. Field data collection from 460 forested plots began in May and continued until the last plot was measured in December, 1978.

Readers should note that because the data was rounded off to reach the numbers used in this report, the column and row totals in some tables may not be the exact sum of the individual cells.

ACKNOWLEDGEMENTS

This project could not have been completed without the willing assistance of numerous groups. DSL, the Intermountain Forest and Range Experiment Station, and Region 1, Cooperative Forestry and Pest Management jointly wish to acknowledge the following agencies, organizations, and individuals for their contributions and cooperation:

Montana Department of Natural Resources and Conservation

Soil Conservation Service

Agricultural Stabilization and Conservation Service

Beaverhead National Forest

Deerlodge National Forest

Flathead National Forest

Gallatin National Forest

Helena National Forest

Lewis and Clark National Forest

Lolo National Forest

Clerk and Recorder's offices in Beaverhead, Broadwater, Deer Lodge, Granite, Jefferson, Lewis and Clark, Madison, Powell, and Silver Bow Counties

Assessors' offices in Beaverhead, Broadwater, Deer Lodge, Granite, Jefferson, Lewis and Clark, Madison, Powell, and Silver Bow Counties

Montana Department of Fish, Wildlife and Parks

Plum Creek Timber Company, Incorporated

Champion International Corporation

USDI Bureau of Land Management

Local landowners who granted access to their lands.

For collecting inventory data, DSL recognizes the forest inventory crew, which included: supervisor Brian Long; inventory foresters Jim Huter, Steve Wallace, Dave Remington, Pete Metzmaker, and Bob Dillon; inventory technicians Kurt Gelderman, Mark Hannah, Steve Jorgenson, Jeff Rupkalvis, and Randy Pearson; and secretary Caroline Flink. For consulting, adopting, and developing special inventory procedures, DSL recognizes: Hal Hunter and Frank Kirschten of the Soil Conservation Service, and Vince Frezzo of the Forestry Division (forest land range inventory); Jeff Jahnke and Paul Klug of the DSL (silvicultural treatment opportunities inventory); Terry Lonner of the Montana Department of Fish, Wildlife, and Parks (wildlife use inventory); and Bill Fischer of the Forest Service (fuel loading inventory). DSL also recognizes: Brian Long and Bob Dillon of the Forestry Division for writing this report; Diane Smith for editing it; Bob Dillon and Kurt Gelderman of the Forestry Division for the photographs used in this report; and the Montana Department of Administration, Publications and Graphics Bureau for helping with the graphics, layout, and printing. Earl Salmonson and Don Artley of the Forestry Division provided direction for the project.

ABBREVIATIONS

AUM	animal unit month
BAF	basal area factor
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CFL	commercial forest land
d.b.h.	diameter at breast height
DNRC	Montana Department of Natural Resources and Conservation
DSL	Montana Department of State Lands
MAI	mean annual increment
MBF	thousand board feet
MBFS	thousand board feet Scribner
MMBF	million board feet
NCFL	noncommercial forest land
NPS	National Park Service
SCS	Soil Conservation Service
USDA	U. S. Department of Agriculture
USDI	U. S. Department of the Interior
USFS	U. S. Forest Service

INTRODUCTION

Geographical Overview

Working Circle 3, located on both sides of the Continental Divide in southwestern Montana, is characterized by diverse and often spectacular geological features. Alpine glaciers have left their mark on the upper elevations, leaving deep U-shaped valleys above broad intermountain basins. Several major rivers flow through the region, including the Clark Fork, the Blackfoot, and two of the Three Forks of the Missouri. Lewis and Clark explored much of the area on their historic trip in 1805 and 1806. Their reports inspired others to explore the area further.

The geologic forces that uplifted and folded the existing terrain also brought rich metal ores within reach. Gold was discovered in July, 1862, along Grasshopper Creek in Beaverhead County, and the Montana gold rush was on. Nearby Bannack became the first Territorial Capital but, in the spring of 1863 rich gold deposits were found in Alder Gulch in Madison County, and the Capital was soon transferred to Virginia City, leaving Bannack a ghost town when the gold played out. Then, on July 14, 1864, gold was discovered in Last Chance Gulch. Helena quickly became the third Territorial Capital, and the State Capital when statehood was bestowed upon Montana.

Mining is still a major industry throughout Working Circle 3, but nowhere has it had as much impact as in Butte, the "Mining City." Other nicknames, such as "The Richest Hill on Earth" and "A Mile High and a Mile Deep," indicate the value of the ore and the lengths miners were willing to go to get at it. The smelter at nearby Anaconda became famous when they erected the world's largest smokestack.

Working Circle 3 has many interesting features which are enjoyed by local residents and visitors from all over the world. Rock Creek and Georgetown Lake are famous for the quality of fishing they offer; Montana's first State park, Lewis and Clark Caverns State Park, is in Working Circle 3, just up the Jefferson River from Three Forks; Red Rock Lakes National Wildlife Refuge, just below the Centennial Mountains in the very southern part of the state, boasts nesting pairs of trumpeter swans (Olor buccinator) as well as other, more common wildlife. Not far from the refuge is Quake

Lake, which was created when a large earthquake on August 17, 1959, slid half a mountain into the Madison River valley, damming the river. Three dams have been built on the Missouri River near Helena, forming Canyon Ferry Lake, Hauser Lake, and Holter Lake, all of which offer a variety of recreation opportunities.

Beaverhead County, the largest county in the state, is located in southwestern Montana on the Idaho border. Of the 8,200 people in the county, nearly half live in Dillon, the county seat. There is one large sawmill, three smaller ones, two log home manufacturers, and one post and pole processor (Montana Department of State Lands, 1983). Broadwater County, on the east side of Working Circle 3, has two sawmills, one large and one small, and a post and pole processor. There are 3,300 people in Broadwater County, and half of them live in Townsend, the county seat. Deer Lodge County has a post and pole producer. About two-thirds of the county's 12,500 residents live in the county seat, Anaconda. There are four small sawmills and a post and pole producer in Granite County. The county seat, Philipsburg, is home for about 40 percent of the county's 2,700 inhabitants. Jefferson County has two small sawmills and three post and pole processors. One-fifth of the 7,000 people in Jefferson County live in Boulder, the county seat.

The northeastern part of Working Circle 3 is in Lewis and Clark County. The county seat, Helena, is also the State Capital. A little more than half of the 43,000 people in Lewis and Clark County live in Helena. There are six small and one large sawmills, one log home manufacturer, and two post and pole processors in Lewis and Clark County. Madison County, in the southeastern part of the working circle, is home for 5,400 people. Only about 200 people live in Virginia City, the county seat and Montana's second Territorial Capital. There are three small sawmills and a post and pole processor in Madison County. Powell County stretches from the northwest boundary almost to the center of Working Circle 3. Deer Lodge is the county seat, and home for more than half of the 7,000 Powell County residents. There are three small and one large sawmills, and a post and pole processor. The smallest county in Montana is Silver Bow. More than half of Silver Bow County's 37,900 inhabitants live in Butte. There are three small sawmills and a post and pole processor in Silver Bow County.

Figure 1.

GEOGRAPHICAL FEATURES OF WORKING CIRCLE 3.



Figure 1.

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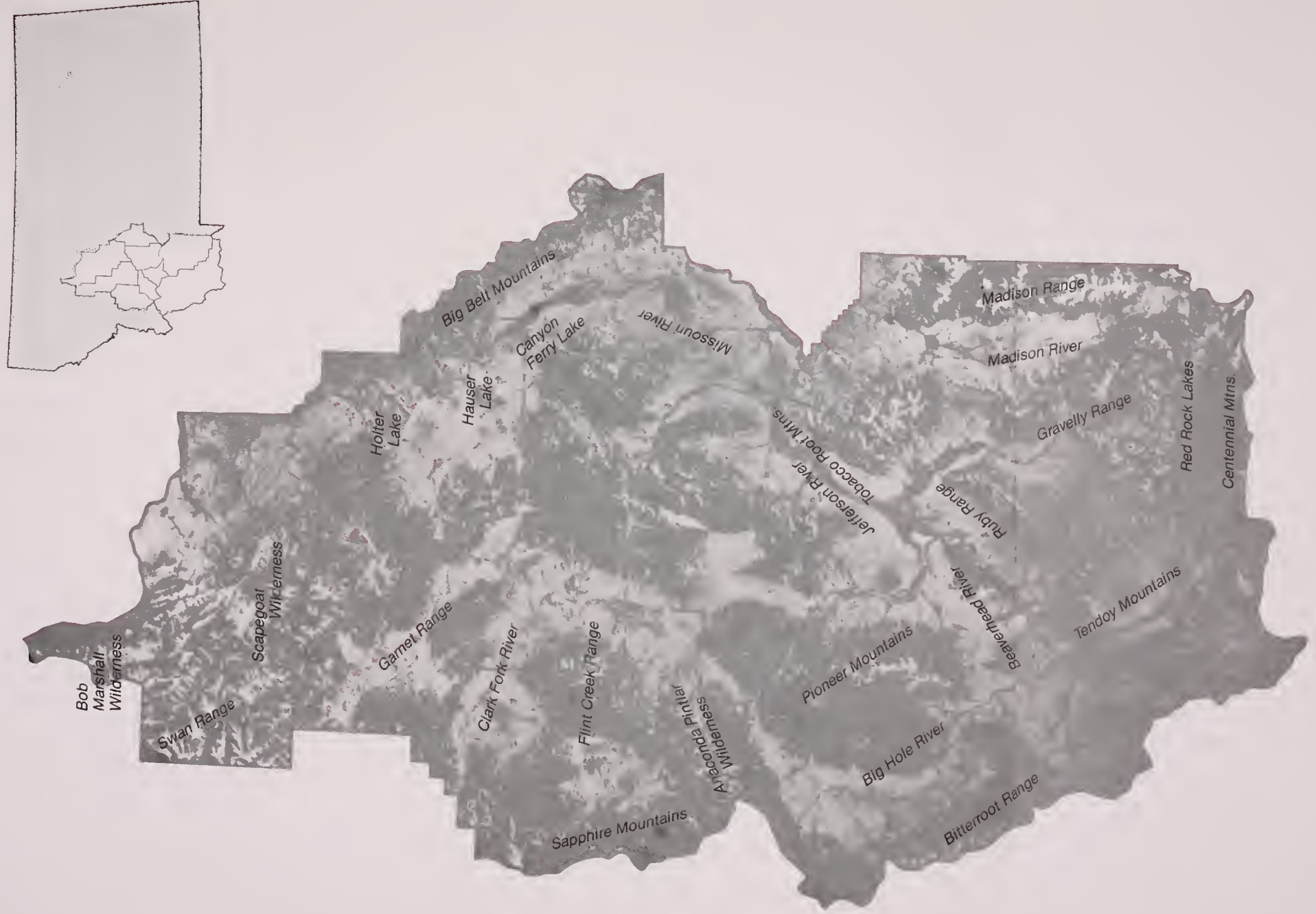


Figure 2.

FOREST COVER MAP OF WORKING CIRCLE 3.

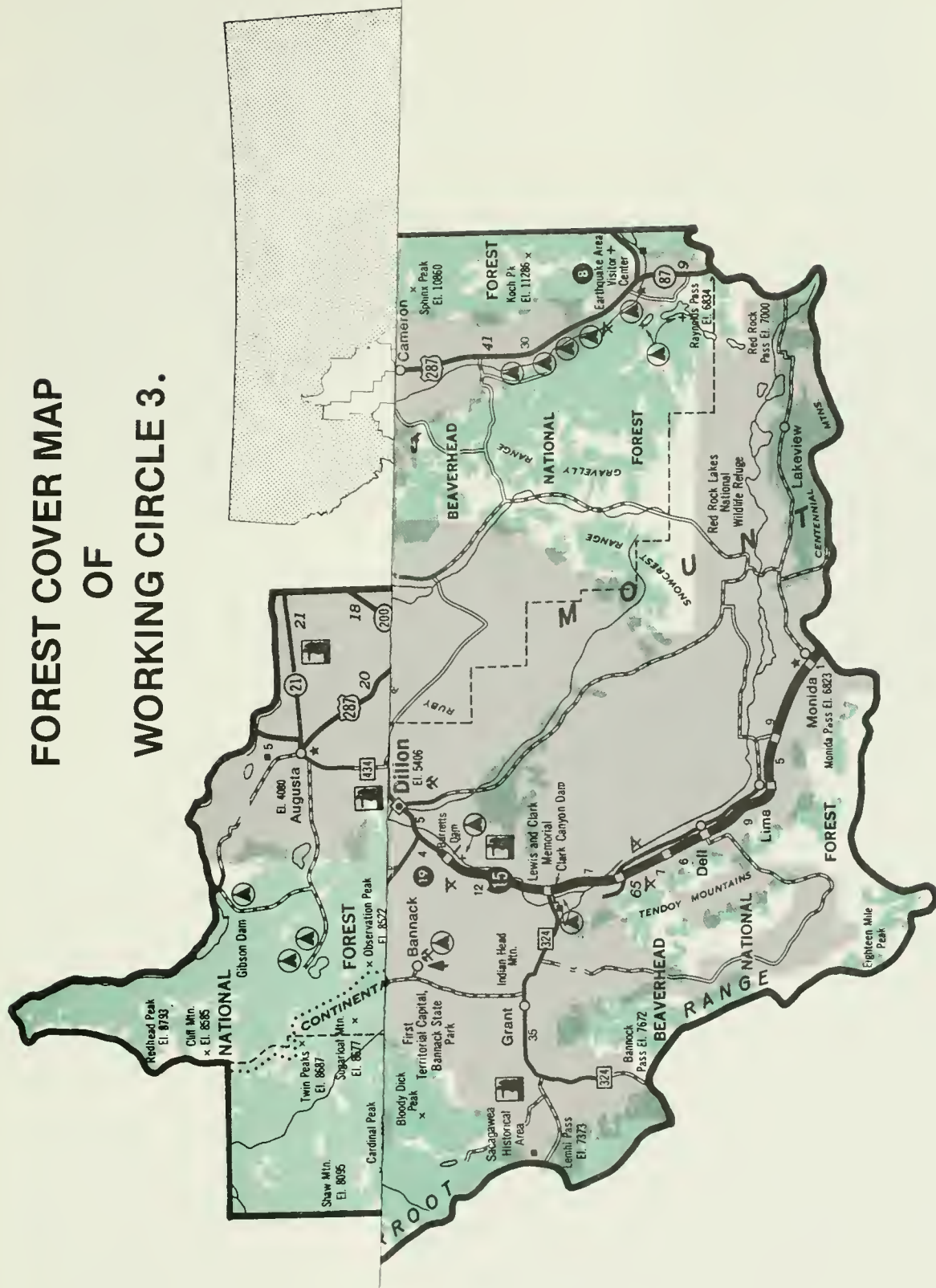


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FOREST COVER MAP OF WORKING CIRCLE 3.

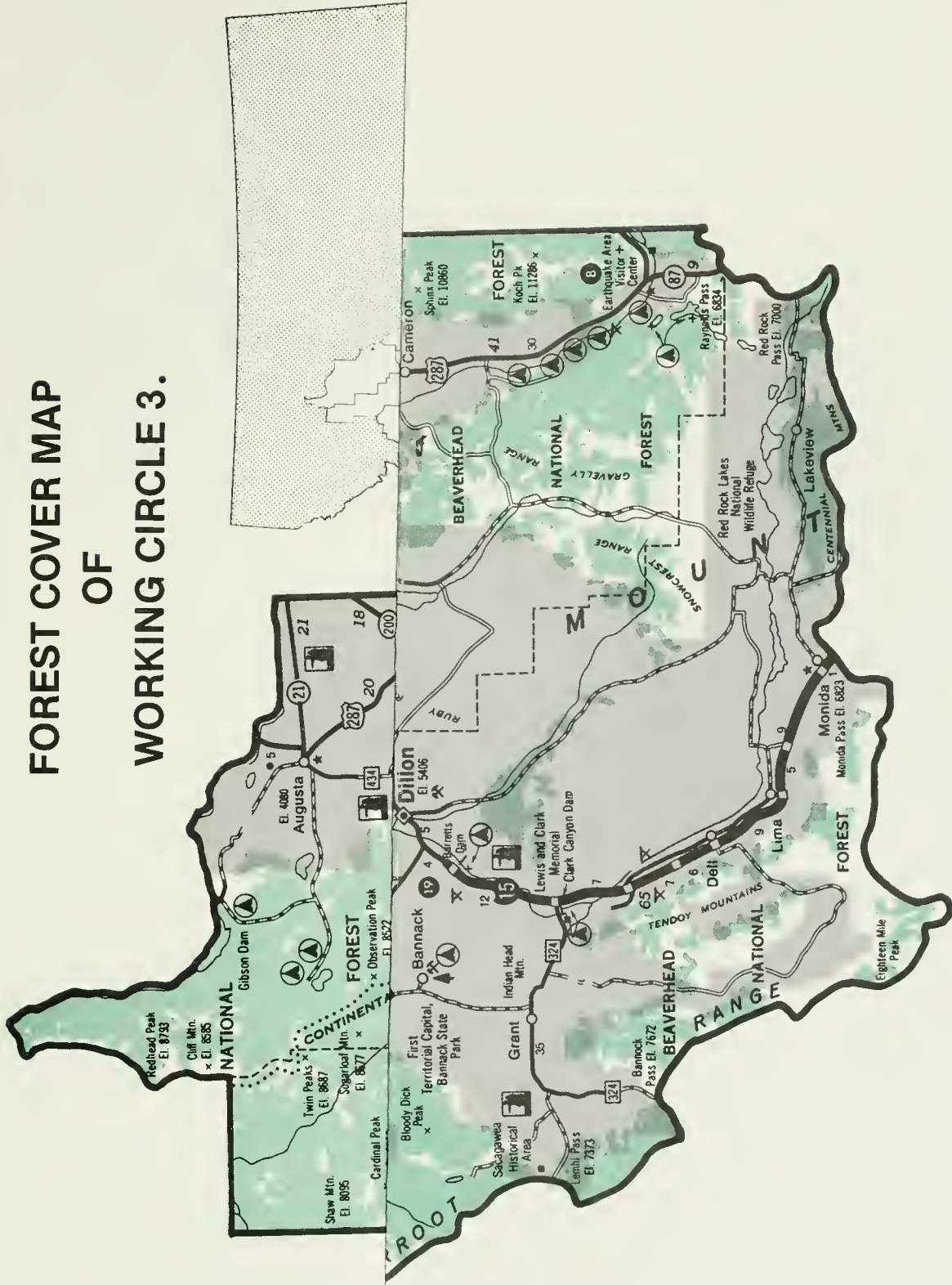


Figure 2.

FOREST COVER MAP OF WORKING CIRCLE 3.



Forest Types

A description of each forest type sampled in Working Circle 3 follows. These descriptions may not be the same for all working circles in the state.

Because more than one tree species can occur within a given forest type, those species that exhibited the largest number of live trees (plurality of stocking) at a sampled location determined the forest type. Individual trees were ranked according to their relative dominance in the plot. In those cases where trees had overstocked a site, smaller or less-dominant trees were not counted. Unless a stand of trees was lightly stocked with poletimber or sawtimber, seedlings and saplings were seldom considered when designating a forest type.

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Douglas-fir Type

Important Statistics

CFL Area (thousand acres)	Percent of CFL Total
655.2	55.5
Net Volume	
928,026 Mft ³	52.8
2,730,970 MBFS	58.4

The Douglas-fir forest type covers more acres and contains more timber volume than any other forest type in Working Circle 3. This type was sampled over a wide range of elevations, from 3,800 feet to 8,400 feet, and was found on all aspects. Douglas-fir (Pseudotsuga menziesii variety glauca) comprised 82 percent of the cubic foot volume found within the type. Lodgepole pine (Pinus contorta variety latifolia) and ponderosa pine (Pinus ponderosa) were most commonly found growing with Douglas-fir.



Lodgepole Pine Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
193.0	16.4
Net Volume	
438,419 Mft ³	25.0
812,781 MBFS	17.4

Stands of lodgepole pine, typically homogeneous, can be found growing on most forest sites except within certain timberline whitebark pine (Pinus albicaulis) habitat types, ponderosa pine habitat types, and the warmer, drier Douglas-fir habitat types. The lodgepole pine forest type was sampled at elevations from 4,100 feet to 8,000 feet. Eighty-six percent of the net cubic foot volume found in the type consisted of lodgepole pine. Douglas-fir and subalpine fir (Abies lasiocarpa) were found to be the most common associate of lodgepole pine.

Generally, the presence and abundance of lodgepole pine reflects the fire history of the area. After a fire or certain harvesting practices, this species will often regenerate into dense stands which tend to stagnate.



Ponderosa Pine Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
139.5	11.8
Net Volume	
122,884 Mft ³	7.0
348,412 MBFS	7.5

The ponderosa pine forest type was sampled at elevations of 3,800 to 5,700 feet. Natural ponderosa pine stands were not found in Beaverhead or Madison Counties. It appears the climate of the forest zones in these two counties is too cold for ponderosa pine (Pfister et al. 1977). Nearly pure stands are most often found on sites where ponderosa pine is the climax species or on the warmer, well-drained Douglas-fir climax sites. Douglas-fir was found to be the most common associate of ponderosa pine.



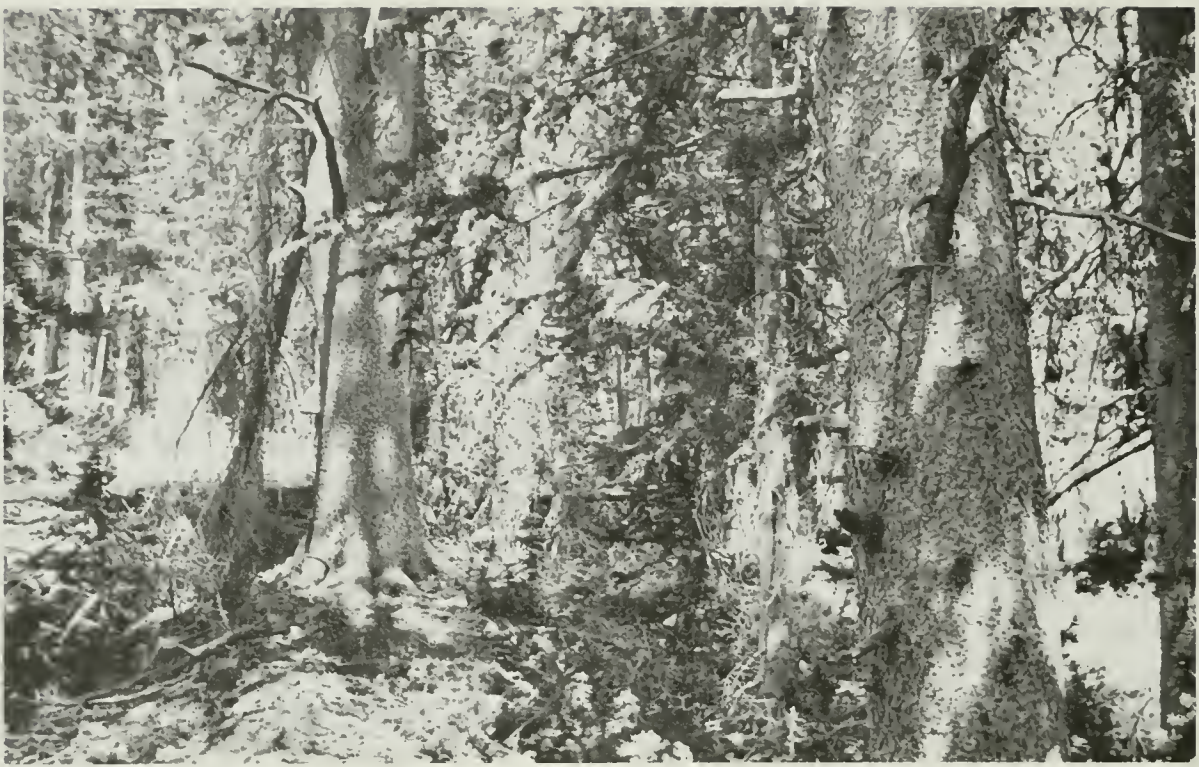
Subalpine Fir-Spruce Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
56.1	4.8
Net Volume	
114,038 Mft ³	6.5
333,315 MBFS	7.1

Commercial stands of the subalpine fir-spruce type were sampled at elevations from 4,100 to 9,200 feet. Besides subalpine fir and spruce (*Picea* species) the most common associated tree species were lodgepole pine and whitebark pine. The sample estimated this forest type to consist of about 40 percent subalpine fir and 30 percent spruce on a cubic foot basis. On the drier, more exposed sites, stands of this type contain very few, if any, spruce trees.

Forest stands of this type tend to be uneven aged and heavily stocked under natural conditions. Subalpine fir is highly shade tolerant and grows in cold, moist climates. It is not a preferred timber species due to the brittle nature of its wood and its susceptibility to heart rot. However, subalpine fir is growing in importance as logging moves higher into the mountains.



Whitebark-Limber Pine Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
35.9	3.0
Net Volume	
44,045 Mft ³	2.5
119,047 MBFS	2.5

This forest type actually represents two very different topographic and climatic extremes. The whitebark pine forest type occurs at the upper elevational limits of commercial timberland. Spruce and subalpine fir were the most commonly found species associated with whitebark pine. This type is often found above or adjacent to the subalpine fir-spruce forest type, on sites too harsh or exposed to be dominated by subalpine fir.

The limber pine forest type can be found on some of the driest sites capable of supporting trees (Pfister et al. 1977). This forest type was found growing just above the grasslands and at mid- to upper-elevations on steep, dry, rocky mountain slopes in the vicinity of the subalpine fir-spruce type. The most commonly associated commercial tree species at lower elevations was Douglas-fir. Limber pine and whitebark pine were rarely found occupying the same sites.

These forest types are not commercially important timber producers.



Juniper Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
18.3	1.6
Net Volume	
9,939 Mft ³	0.6
33,197 MBFS	0.7

The juniper forest type grows on dry, rocky sites over a wide range of elevations. Stands were sampled at elevations of 4,300 to 6,500 feet. Most juniper (Juniperus scopulorum) stands are found on sites that are not capable of producing 20 cubic feet of wood per acre per year under natural conditions. Commercial timberland classified into this forest type contained Douglas-fir, lodgepole pine and/or ponderosa pine. In some parts of the state, juniper is used for fence posts and firewood. However, the volume shown for each forest type does not include juniper because it is not considered a commercial species in Montana.



Spruce Type

Important Statistics	
CFL Area (thousand acres)	Percentage of CFL Total
3.6	*
Net Volume	
989 Mft ³	*
-- MBFS	--

In Montana, the most common species of spruce is Engelmann spruce (Picea engelmannii), although in many stands Engelmann spruce has hybridized with white spruce (Picea glauca). Occasionally a stand containing white spruce can be found (Pfister et al. 1977).

Spruce is commonly found growing in cool ravines, along streams and lakes, or in areas with a high water table. It also can be found growing at or near the timberline in association with whitebark pine and subalpine fir. One stand was sampled at 6,400 feet.

*Indicates less than 0.05%.



Western Larch Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
1.2	*
Net Volume	
2,278 Mft ³	*
10,461 MBFS	*

Like lodgepole pine, the presence of old growth western larch (Larix occidentalis) reflects the fire history of the area. Western larch is the least shade tolerant commercial tree species in the northern Rockies (Schmidt et al., 1976). To regenerate harvested larch stands, even-aged management techniques including clearcutting, shelterwood, and seed-tree methods are used to create conditions similar to those that follow wildfires.

Western larch always occurs as a seral component of the forest and can be found growing over a wide range of ecological conditions. The most common associate was Douglas-fir, with lesser amounts of lodgepole pine and ponderosa pine. Naturally regenerated stands are found only west of the Continental Divide in Working Circle 3.

*Indicates less than 0.05%



Aspen Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
45.2	3.8
Net Volume	
51,560 Mft ³	2.9
126,145 MBFS	2.7

Aspen (Populus tremuloides) stands usually occur on moist sites adjacent to or among conifer stands. The aspen forest type was sampled at elevations of 4,200 to 6,300 feet. The most commonly associated species were lodgepole pine and ponderosa pine.

Periodic wildfires seem necessary for aspen stands to perpetuate (Pfister et al. 1977). In areas where wildfires have successfully been suppressed, aspen stands seem to be succeeding towards conifer stands.

Aspen is not an important commercial species in Working Circle 3. However, there has been some recent experimentation in using aspen as feed for cattle.



Cottonwood Type

Important Statistics

CFL Area (thousand acres)	Percentage of CFL Total
31.9	2.7
Net Volume	
44,718 Mft ³	2.5
164,997 MBFS	3.5

Stands of cottonwood (Populus trichocarpa) grow along rivers and streams throughout the working circle. The cottonwood forest type was sampled at elevations of 3,600 to 5,700 feet. Most of the stands were comprised almost entirely of cottonwood. Ninety-six percent of the estimated cubic foot volume for this type is cottonwood. Although this type is not commercially important, cottonwood stands serve an important role in maintaining river and stream bank stability.

Inventory Procedures

The timber resource inventory was designed to provide inventory data for the individual working circles in Montana and the state as a whole. Because reliable county data was desired in Working Circle 3, a large number of field plots were sampled. This allowed the data to be stratified further to provide better information at the county level.

Forest inventory data was collected on all private, state, county, municipal, and some miscellaneous federal lands in the working circle. These miscellaneous federal lands included USDI Fish and Wildlife Service lands, lands within national monuments, and lands controlled by the U.S. Army Corps of Engineers and the USDI Bureau of Reclamation. The sampled area, which totalled 6.6 million acres, included forested and nonforested lands. (NOTE: Timber Resources on USDA Forest Service, USDI Bureau of Land Management, and National Park Service Lands were not inventoried).

Sample points were selected, measurements taken, and data analyzed through the following methods:

1. Initial area estimates were based on the classification of 52,463 sample points systematically placed on the latest aerial photographs available. The dates of these photos ranged from 1955 to 1976; most were 1972 photos. The sample points were summarized and grouped into strata for subsequent field sampling. The photo points, adjusted to meet known land areas, were used to compute area expansion factors for the field stratum means.

2. Land classification and estimates of timber characteristics and volume were based on observations and measurements recorded at 460 ground sample locations. Sample trees were selected using a 10-point cluster that included fixed plots (1/300 acre) for trees less than 5.0 inches d.b.h. and variable plots (40 BAF) for trees 5.0 inches d.b.h. or larger.

3. All photo and field data was sent to the Intermountain Experiment Station in Ogden, Utah, to be punched onto computer cards and stored for machine computing, sorting, and tabulation. Computerized edits were sent to the inventory crew for corrections. Final estimates were based on statistical summaries of the data.

Data reliability is listed in Appendix 1.

MAJOR INVENTORY FINDINGS

The Timber Resource

The total sampled area was 6.6 million acres of which 1.2 million acres (18 percent) were classified as commercial timberland. About 70 percent of the sampled timberland was owned by the other private ownership group, 16 percent was owned by forest industries, and 14 percent was state owned. Douglas-fir was found to be the dominant forest type, covering 56 percent of the commercial timberland. Growing stock net volume was estimated to be 1.7 billion cubic feet and sawtimber volume was estimated to be 4.7 billion board feet Scribner. Annual growing stock net growth totaled 37.1 million cubic feet and sawtimber totaled 107.2 million board feet. Annual mortality was estimated to be 5.5 million cubic feet or 13.6 million board feet. The average acre of commercial timberland had the potential to produce 54 cubic feet per acre per year. About 54 percent of the timberland had the potential to produce 50 or more cubic feet per acre per year.

Area By Ownership Group

Table 1 shows the acreage and percentage of land in Working Circle 3 owned or administered by the different owners. As this table shows, public agencies owned or administered 58 percent of the land. The USDA Forest Service administered the largest portion of this public land, as well as most of the forested land in the working circle.

The proportion of the sampled lands -- private, state, county, municipal, and miscellaneous federal -- owned or administered by different ownership groups is shown in Figure 3. The total sampled area was 6.6 million acres which included nonforest land as well as forest.

Of the commercial forest land sampled, about 61 percent, or 722,500 acres, was owned by farmers and ranchers (see Table 2). Another 16 percent was owned by forest industries (see Figure 4). The State of Montana owned an additional 14 percent of the commercial timberland sampled.

Table 1. Total land area by owner, Working Circle 3 (acres).

Owner	Acreage	Percentage of Total
Public:		
USDA Forest Service	5,477,126	40.9
USDI Bureau of Land Management	1,321,821	9.9
USDI National Park Service	2,184	*
Miscellaneous Federal	49,613	0.4
State	947,320	7.1
County and Municipal	6,175	*
Subtotal	<u>7,804,239</u>	<u>58.2</u>
Private:		
Forest Industry	243,141	1.8
Private	5,355,335	40.0
Subtotal	<u>5,598,476</u>	<u>41.8</u>
Total Land Area	<u>13,402,715</u>	<u>100.0</u>

Table 2. Area of commercial timberland and other forest land by owner, Working Circle 3 (thousand acres).

Owner	Commercial Timberland	Other Forest Land	All Forest Land	Percentage of Total
	-----thousand acres-----			
Public:				
Montana Department of State Lands	113.2	5.5	118.7	9.5
Other state	49.1	3.4	52.5	4.2
Miscellaneous federal	3.1	0.1	3.2	0.3
County and municipal	**	-	**	*
Subtotal	<u>165.3</u>	<u>9.0</u>	<u>174.3</u>	<u>14.0</u>
Private:				
Forest industry	186.9	2.9	189.8	15.2
Farmer/rancher	722.5	48.8	771.3	61.9
Other private - corporate	42.5	2.3	44.8	3.6
Other private - individual	62.7	2.3	65.0	5.2
Subtotal	<u>1,014.6</u>	<u>56.3</u>	<u>1,070.9</u>	<u>86.0</u>
Total	<u>1,180.0</u>	<u>65.3</u>	<u>1,245.3</u>	<u>100.0</u>

*Indicates less than 0.05 percent.

**Indicates less than 50 acres.

Figure 3. Proportion of the total sampled area (forest and nonforest) by ownership group, Working Circle 3.

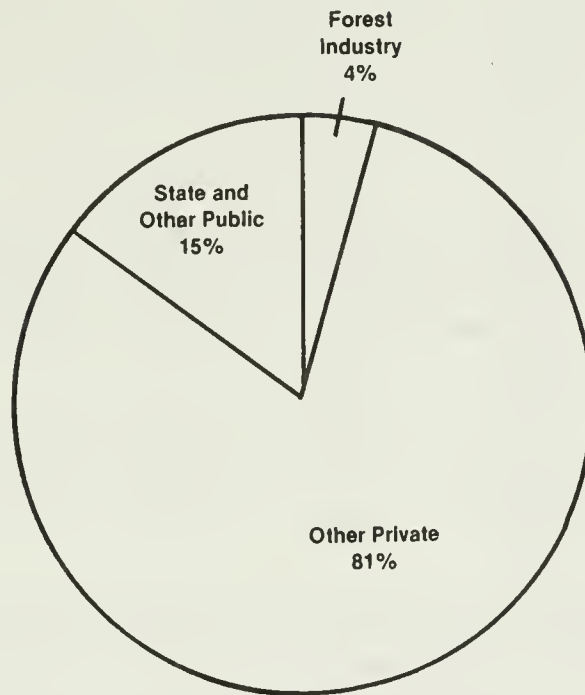
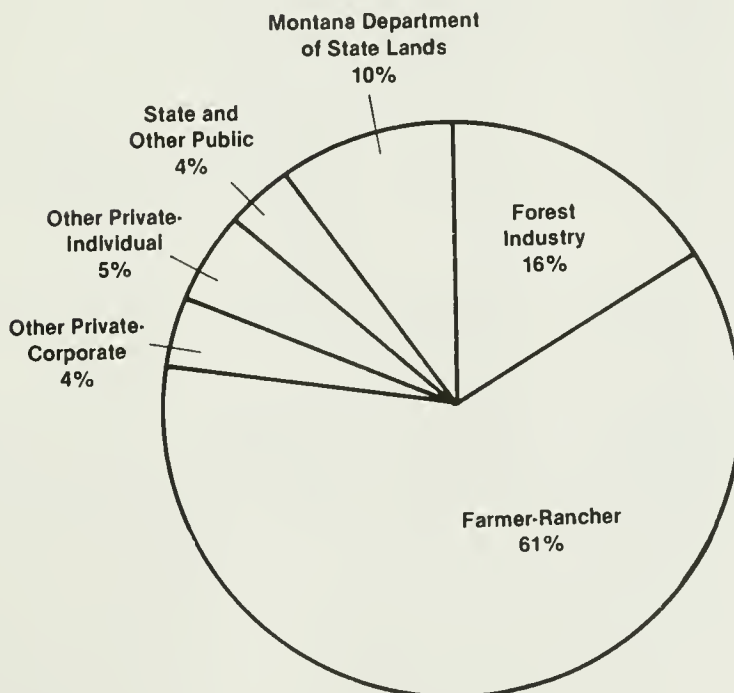


Figure 4. Proportion of the sampled commercial timberland area by ownership class, Working Circle 3.



Forest Type Acreage

Douglas-fir, lodgepole pine and ponderosa pine forest types together comprised 84 percent of the total commercial timberland acreage (see Table 3).

Volume Estimates

The Douglas-fir, lodgepole pine, and ponderosa pine forest types contained 85 percent of the total growing stock cubic foot volume and 83 percent of the total sawtimber board foot volume occurring on sampled land in Working Circle 3 (see Tables 4 and 5).

About 65 percent of the total sampled volume belonged to owners in the other private ownership group. About 20 percent was owned by forest industries. These percentages apply to both board foot and cubic foot volumes.

The volume by species is compared by ownership groups in Tables 6 and 7. As shown, Douglas-fir and lodgepole pine made up 76 percent of the total cubic foot volume and 73 percent of the total board foot volume.

The average volume per acre for all sampled lands was estimated to be 4,000 board feet Scribner.

Table 3. Area of commercial timberland by forest type and ownership group, Working Circle 3 (thousand acres).

Forest Type	Ownership Group			Total	Percentage of Total
	State and	Forest	Other		
	Other Public	Industry	Private		
	-----thousand acres-----				
Douglas-fir	86.8	113.1	455.3	655.2	55.5
Lodgepole pine	33.8	39.0	120.2	193.0	16.4
Ponderosa pine	19.0	9.2	111.3	139.5	11.8
Subalpine fir-spruce	7.8	12.9	35.4	56.1	4.8
Whitebark-limber pine	6.3	5.3	24.3	35.9	3.0
Juniper	2.5	0.7	15.1	18.3	1.6
Spruce	0.6	0.9	2.2	3.6	0.3
Western larch	-	1.2	-	1.2	0.1
Softwood types	156.8	182.3	763.8	1,102.9	93.5
Aspen	4.4	2.9	38.0	45.2	3.8
Cottonwood	4.3	1.7	26.0	31.9	2.7
Hardwood types	8.6	4.6	63.9	77.1	6.5
All forest types	165.4	186.9	827.7	1,180.0	100.0

Table 4. Net volume of growing stock on commercial timberland by forest type and ownership group, Working Circle 3 (thousand cubic feet).

Forest Type	Ownership Group			Total	Percentage of Total
	State and	Forest	Other		
	Other Public	Industry	Private		
	-----thousand cubic feet-----				
Douglas-fir	127,021	199,350	601,654	928,026	52.8
Lodgepole pine	82,131	103,722	252,638	438,491	25.0
Ponderosa pine	18,764	6,631	97,489	122,884	7.0
Subalpine fir-spruce	17,140	23,742	73,157	114,038	6.5
Whitebark-limber pine	8,440	8,242	27,362	44,045	2.5
Juniper	1,364	403	8,173	9,939	0.6
Spruce	160	237	592	989	0.1
Western larch	-	2,278	-	2,278	0.1
Softwood types	255,020	344,605	1,061,065	1,660,690	94.6
Aspen	4,250	1,022	46,288	51,560	2.9
Cottonwood	6,561	1,221	36,937	44,718	2.5
Hardwood types	10,811	2,243	83,225	96,278	5.4
All forest types	265,831	346,848	1,144,290	1,756,968	100.0

Table 5. Net volume of sawtimber on commercial timberland by forest type and ownership group, Working Circle 3 (thousand board feet Scribner).

Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Douglas-fir	373,779	664,729	1,692,462	2,730,970	58.4
Lodgepole pine	167,025	196,425	449,332	812,781	17.4
Ponderosa pine	53,062	25,062	270,289	348,412	7.5
Subalpine fir-spruce	48,261	71,511	213,543	333,315	7.1
Whitebark-limber pine	22,780	23,280	72,987	119,047	2.5
Juniper	4,441	1,345	27,410	33,197	0.7
Spruce	-	-	-	-	-
Western larch	-	10,461	-	10,461	0.2
Softwood types	669,348	992,813	2,726,023	4,388,183	93.8
Aspen	8,478	3,937	113,730	126,145	2.7
Cottonwood	24,108	3,710	137,179	164,997	3.5
Hardwood types	32,586	7,647	250,909	291,142	6.2
All forest types	701,934	1,000,460	2,976,932	4,679,326	100.0

Table 6. Net volume of growing stock on commercial timberland by species and ownership group, Working Circle 3 (thousand cubic feet).

Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Douglas-fir	113,373	182,795	530,155	826,323	47.0
Lodgepole pine	89,508	103,633	309,806	502,947	28.6
Ponderosa pine	21,310	19,450	114,350	155,110	8.8
Subalpine fir	10,727	13,453	36,898	61,078	3.5
Whitebark-limber pine	10,037	9,924	33,406	53,367	3.1
Spruce	8,235	7,276	36,640	52,150	3.0
Western larch	1,181	8,917	993	11,090	0.6
Softwood species	254,371	345,447	1,062,248	1,662,066	94.6
Aspen	4,178	464	40,963	45,604	2.6
Cottonwood	7,175	917	40,757	48,849	2.8
Other hardwoods	105	21	321	449	*
Hardwood species	11,460	1,401	82,041	94,902	5.4
Total all species	265,831	346,848	1,144,289	1,756,968	100.0

*Indicates less than 0.05 percent.

Figure 5. Net volume of softwood growing stock on commercial timberland by species and ownership group, Working Circle 3 (thousand cubic feet).

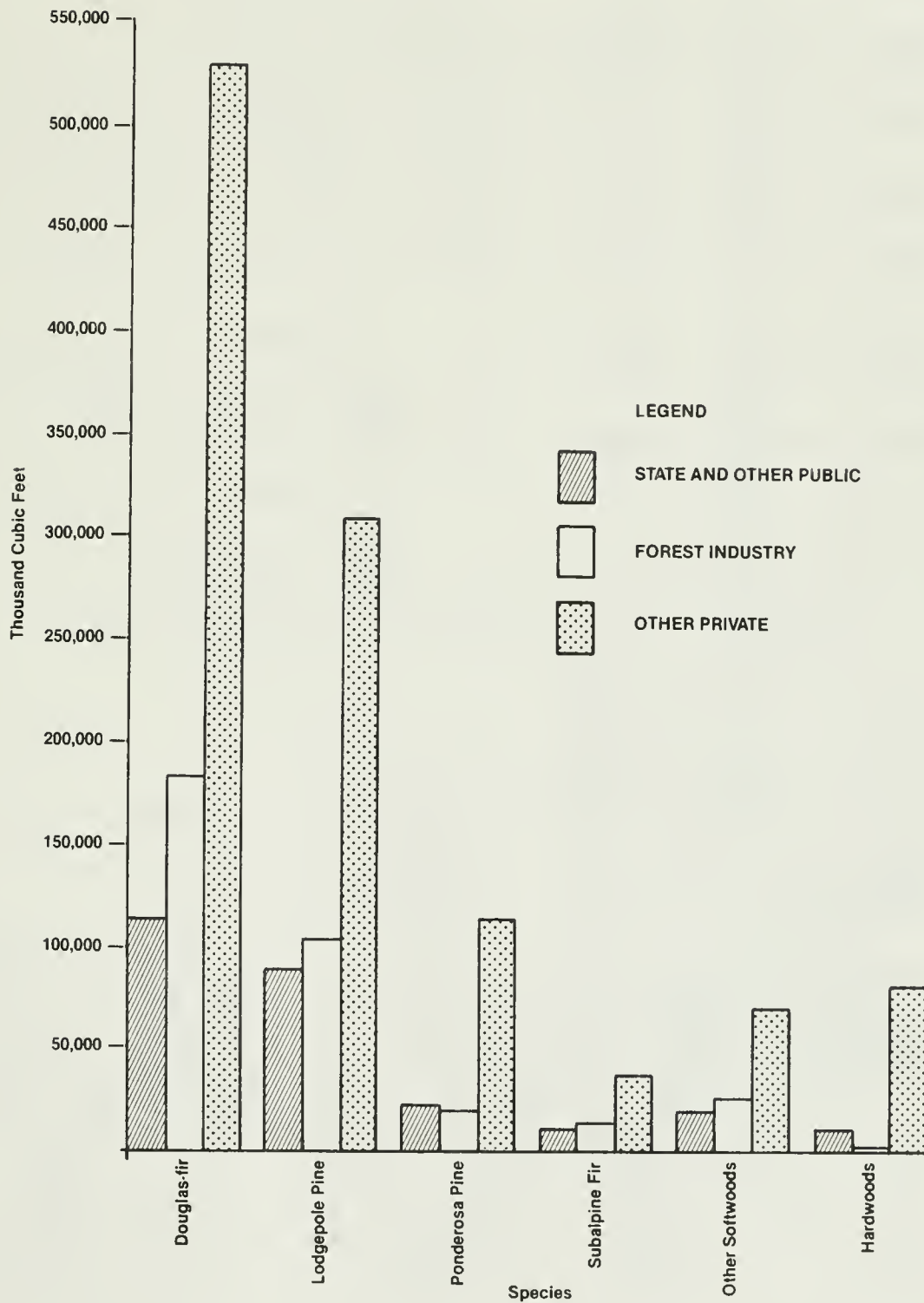


Figure 6. Net volume of softwood sawtimber on commercial timberland by species and ownership group, Working Circle 3 (thousand board feet Scribner).

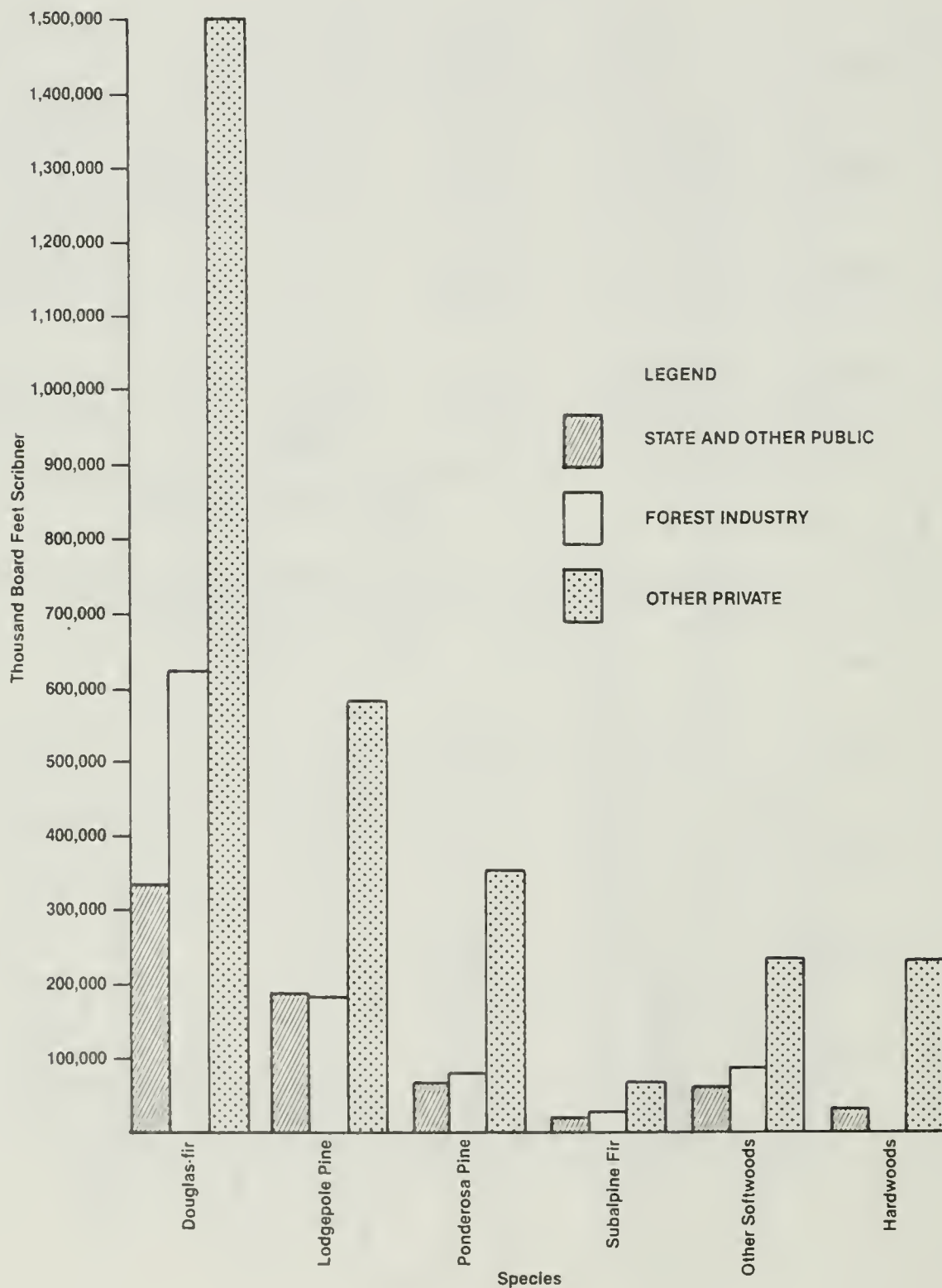


Table 7. Net volume of sawtimber on commercial timberland by species and ownership group, Working Circle 3 (thousand board feet Scribner).

Species	Ownership Group				Percentage of Total
	State and Other Public	Forest Industry	Other Private	Total	
	-----thousand board feet-----				
Douglas-fir	333,558	621,205	1,503,587	2,458,350	52.5
Lodgepole pine	186,986	182,741	584,555	954,283	20.4
Ponderosa pine	66,294	79,558	353,067	498,919	10.7
Subalpine fir	19,285	27,369	67,493	114,147	2.4
Whitebark-limber pine	27,710	27,416	88,420	143,546	3.1
Spruce	29,106	27,759	141,965	198,829	4.2
Western larch	5,577	30,765	3,628	39,970	0.9
Softwood species	<u>668,516</u>	<u>996,814</u>	<u>2,742,715</u>	<u>4,408,044</u>	<u>94.2</u>
Aspen	6,359	500	79,229	86,088	1.9
Cottonwood	26,885	3,113	154,464	184,462	3.9
Other hardwoods	<u>174</u>	<u>34</u>	<u>523</u>	<u>731</u>	<u>*</u>
Hardwood species	<u>33,418</u>	<u>3,646</u>	<u>234,217</u>	<u>271,281</u>	<u>5.8</u>
Total all species	<u>701,934</u>	<u>1,000,460</u>	<u>2,976,932</u>	<u>4,679,326</u>	<u>100.0</u>

*Indicates less than 0.05 percent.

Table 8. Net annual growth of growing stock on commercial softwood and hardwood forest types by ownership group, Working Circle 3 (thousand cubic feet).

Ownership Group	Forest Type		
	Softwood Types	Hardwood Types	Total
	-----thousand cubic feet-----		
State and Other Public	5,511	256	5,767
Forest Industry	5,386	62	5,448
Other Private	<u>24,148</u>	<u>1,761</u>	<u>25,909</u>
All Owners	35,045	2,079	37,124

Table 9. Net annual growth of sawtimber on commercial softwood and hardwood forest types by ownership group, Working Circle 3 (thousand board feet Scribner).

Ownership Group	Forest Type		
	Softwood Types	Hardwood Types	Total
	-----thousand board feet-----		
State and Other Public	15,180	781	15,961
Forest Industry	18,993	201	19,194
Other Private	<u>65,676</u>	<u>6,387</u>	<u>72,063</u>
All Owners	<u>99,849</u>	<u>7,369</u>	<u>107,218</u>

Growth and Mortality by Ownership Group

Growth Commercial timberlands on state and private lands in Working Circle 3 were growing at an annual rate of 37,124,000 net cubic feet or 107,218,000 net board feet Scribner (see Tables 8 and 9). Over time, net growth will change depending on such factors as the forest's overall age, condition, mortality rates, and the amount of harvest.

Most of the cubic foot and board foot net growth -- about 70 percent -- took place on the other private owner group's timberland. Net growth in cubic feet per acre was highest on timberlands owned by the state and other public ownership group. Net growth in board feet per acre was highest on timberlands owned by forest industries (see Table 12). Trees on an average acre of timberland in Working Circle 3 grew 31.5 net cubic feet or 102 net board feet Scribner per year.

Mortality The data shows that state and private timberlands in Working Circle 3 lose 5,515,000 net cubic feet of growing stock or 13,562,000 net board feet of sawtimber annually due to natural mortality (see Tables 10 and 11). This timber is removed from the commercial growing stock by natural causes such as insects, disease, fire, and weather. Timber removed through logging is not considered when computing mortality figures.

On a per acre basis, mortality rates appear to be highest on forest industry-owned lands and lowest on other private timberlands (see Table 12). The average annual mortality rate in the working circle was 4.7 cubic feet of growing stock per acre, or 12 board feet Scribner per acre for sawtimber.

Table 10. Net annual mortality of growing stock on commercial softwood and hardwood forest types by ownership group, Working Circle 3 (thousand cubic feet).

Ownership Group	Forest Type		Total
	Softwood Types	Hardwood Types	
	-----thousand cubic feet-----		
State and Other Public	669	29	699
Forest Industry	1,817	1	1,818
Other Private	<u>2,841</u>	<u>157</u>	<u>2,998</u>
All Owners	5,327	188	5,515

Area by Site Class

Commercial timberland was placed in one of five productivity classes (see Tables 13 and 14). As shown in Table 14, almost half of the timberland -- 46 percent -- had the potential to produce from 50 to 84 cubic feet of timber per acre per year. An almost equal amount of timberland had the potential to produce from 20 to 49 cubic feet of timber per acre per year. An average sampled acre of commercial timberland had the potential to produce 54 cubic feet of timber per year. This is below the average potential yield for the entire United States -- 74 cubic feet per acre per year -- and slightly below the Rocky Mountain region's average of 60 cubic feet per acre per year (USDA Forest Service 1973). (Average potential productivity for the different forest types in Working Circle 3 is shown in Table 23, page 45).

Table 14 indicates the forest industry-owned timberlands had the highest average potential productivity when compared to the other ownership groups.

Table 11. Net annual mortality of sawtimber on commercial softwood and hardwood forest types by ownership group, Working Circle 3 (thousand board feet Scribner).

Ownership Group	Forest Type		Total
	Softwood Types	Hardwood Types	
	-----thousand board feet-----		
State and Other Public	1,372	83	1,454
Forest Industry	5,071	5	5,075
Other Private	<u>6,547</u>	<u>485</u>	<u>7,032</u>
All Owners	12,989	572	13,562

Table 12. Net annual mortality and net and gross growth per acre for commercial softwood forest types by ownership group, Working Circle 3 (cubic feet and board feet Scribner).

	Ownership Group			
	State and Other Public	Forest Industry	Other Private	Working Circle Total
Mortality				
Ft ³ /acre	4.2	9.7	3.6	4.7
BFS/acre	8.8	27.2	8.5	11.5
Net Growth				
Ft ³ /acre	34.9	29.1	31.3	31.5
BFS/acre	96.5	102.7	87.1	90.9
Gross Growth				
Ft ³ /acre	39.1	38.9	34.9	36.1
BFS/acre	105.3	129.8	95.6	102.4

Table 13. Area of commercial timberland by forest type and M.A.I. site class, Working Circle 3 (thousand acres).

Forest Type	Site Class (cubic feet/acre/year)					All Classes
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
Douglas-fir	289.6	330.3	28.4	7.0	-	655.2
Lodgepole pine	63.3	115.7	12.7	1.3	-	193.0
Ponderosa pine	101.1	29.6	8.8	-	-	139.5
Subalpine fir-spruce	7.5	41.4	7.3	-	-	56.1
Whitebark-limber pine	29.7	2.6	3.5	-	-	35.9
Juniper	14.4	2.1	1.8	-	-	18.3
Spruce	3.6	-	-	-	-	3.6
Western larch	-	1.2	-	-	-	1.2
All softwood types	509.2	522.8	62.5	8.3	-	1,102.9
Aspen	19.1	13.0	13.1	-	-	45.2
Cottonwood	20.4	11.5	-	-	-	31.9
All hardwood types	39.5	24.5	13.1	-	-	77.1
All forest types	548.7	547.3	75.7	8.3	-	1,180.0

Table 14. Area of commercial timberland by M.A.I. site class and ownership group, Working Circle 3 (thousand acres).

Site Class (ft ³ /acre/year)	Ownership Group							
	State and Other Public		Forest Industry		Other Private		Working Circle Total	
	-----thousand acres-----		-----thousand acres-----		-----thousand acres-----		-----thousand acres-----	
	%		%		%		%	
20 - 49	77.5	46.9	47.1	25.2	424.1	51.2	548.7	46.5
50 - 84	76.3	46.1	122.2	65.3	348.8	42.1	547.3	46.4
85 - 119	9.2	5.6	13.8	7.4	52.7	6.4	75.7	6.4
120 - 164	2.4	1.4	3.9	2.1	2.1	0.3	8.3	0.7
165+	-	-	-	-	-	-	-	-
Total	165.4	100.0	186.9	100.0	827.7	100.0	1,180.0	100.0

The Grazable Forest Land Resource

Of the commercial timberland sampled, 906,500 acres were found to be grazable. An estimated 81 percent of this land was classified as being in good or excellent condition. The carrying capacity on the grazable forest land was judged to be 127,948 AUM's. If every acre of grazable forest land had been in excellent condition, the potential available carrying capacity would be 172,277 AUM's. Actual available carrying capacity was 74 percent of potential.

Range condition, an estimate of the departure from climax based on the species composition of the understory vegetation, was calculated for each commercial field location. It was assumed that the forage potential of understory vegetation in stands of timber with a crown density greater than 70 percent was so low that these sites were not sampled. Also, although unproductive forest lands have the potential to produce relatively large amounts of forage, these lands contained few inventory plots and were not sampled for range condition.

The data summarized in Tables 15 through 17 was obtained from grazing guides developed by the SCS. Appendix 7 contains a sample grazing guide and an example of the field data form used.

Overall Condition

Understory vegetation was estimated to be in good or excellent condition on 729,800 acres of commercial timberland or 81 percent of the grazable timberland. Understory vegetation on another 176,700 acres was found to be in fair or poor condition. The remaining 273,500 acres had crown densities greater than 70 percent (see Table 15).

Commercial timberlands with crown densities of 0-30 percent were the most overgrazed. About 34 percent of these areas were in fair or poor condition. Fourteen percent of the lands within the 31-50 percent crown density group and the 51-70 percent group had understory vegetation in poor or fair condition.

A comparison of the relative amounts of grazable timberland in fair or poor condition between ownership groups showed almost no difference. Each ownership group had about 17 to 20 percent of its grazable timberland in fair or poor condition.

There were 176,700 acres of state and private forested range land in fair or poor condition which, unless the condition of the land is currently improving, need re-evaluation of their stocking rates. Grazable timberland that was rated as good or excellent could also be experiencing overgrazing.

Forest understories that are experiencing overgrazing should be rested by reducing or eliminating grazing for a period of time. This will allow the natural balance within the plant community to be restored and ultimately increase the forage suitable for grazing. If the understory is not rested and the overgrazing continues, the range condition will keep declining until the forage is virtually worthless for grazing. Overgrazing can also impair the health of livestock, reduce water quality, and adversely affect other resources.

Table 15. Area of commercial timberland by condition class, crown density, and ownership group, Working Circle 3 (thousand acres).

Condition class and crown density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
Excellent	-----thousand acres-----			
0 - 30	7.5	8.7	39.8	56.0
31 - 50	21.6	19.9	88.5	130.0
51 - 70	22.8	35.5	104.8	163.1
Total	51.8	64.1	233.2	349.1
Good				
0 - 30	10.3	23.4	72.0	105.7
31 - 50	20.6	9.1	115.8	145.5
51 - 70	18.2	18.1	93.3	129.5
Total	49.0	50.5	281.1	380.7
Fair				
0 - 30	5.4	11.0	51.1	67.5
31 - 50	4.7	7.2	33.0	44.9
51 - 70	6.3	3.2	28.2	37.8
Total	16.4	21.5	112.3	150.1
Poor				
0 - 30	1.7	0.1	12.9	14.7
31 - 50	0.9	-	-	0.9
51 - 70	2.4	1.3	7.3	11.0
Total	5.0	1.5	20.2	26.6
Crown Density Totals				
0 - 30	24.8	43.2	175.8	243.8
31 - 50	47.8	36.2	237.3	321.3
51 - 70	49.7	58.1	233.6	341.4
71+	43.2	49.4	181.0	273.5
Working Circle Totals	165.4	186.9	827.7	1,180.0

Current Carrying Capacity

The current carrying capacity, expressed as available animal unit months or AUM's, is drawn from the condition of the forest's understory vegetation, crown density, and an adjustment based on the amount of the area that will be grazed by livestock (primarily cattle). This adjustment is called a grazability factor or utilization cut.

The available AUM's shown in Table 16 are actually recommended livestock stocking rates (see the definition of animal units in the glossary). According to the Montana grazing guides, if these stocking rates are followed, understory conditions will gradually improve. Sound range management, including grazing during the correct season of the year and proper distribution of livestock over the grazable forested area, must also be applied.

The total carrying capacity or recommended stocking rate for sampled commercial timberland in Working Circle 3 was estimated to be 127,947 AUM's. Most of this carrying capacity occurred on timberlands with 0-30 percent crown canopies, where shading from tall brush and trees does not inhibit the growth of grazable forage.

Grazable timberlands within the other private ownership group could support 91,794 AUM's, or 72 percent of the working circle total (see Table 16).

Table 16. Available animal unit months (AUM's) on commercial timberlands by condition class, crown density, and ownership group, Working Circle 3.

Condition Class and Crown Density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
	-----AUM's-----			
Excellent				
0 - 30	2,540	2,423	11,426	16,389
31 - 50	3,947	3,214	17,754	24,915
51 - 70	2,179	2,727	10,204	15,110
Total	<u>8,666</u>	<u>8,364</u>	<u>39,384</u>	<u>56,414</u>
Good				
0 - 30	2,410	5,705	15,588	23,703
31 - 50	2,543	1,139	14,766	18,448
51 - 70	1,423	1,366	8,050	10,839
Total	<u>6,376</u>	<u>8,210</u>	<u>38,404</u>	<u>52,990</u>
Fair				
0 - 30	939	1,790	9,002	11,731
31 - 50	304	633	2,337	3,274
51 - 70	249	99	1,273	1,621
Total	<u>1,492</u>	<u>2,522</u>	<u>12,612</u>	<u>16,626</u>
Poor				
0 - 30	203	18	1,393	1,614
31 - 50	303	-	-	303
51 - 70	*	*	1	1
Total	<u>506</u>	<u>18</u>	<u>1,394</u>	<u>1,918</u>
Crown Density Totals				
0 - 30	6,092	9,936	37,409	53,437
31 - 50	7,097	4,986	34,857	46,940
51 - 70	<u>3,851</u>	<u>4,192</u>	<u>19,528</u>	<u>27,571</u>
Working Circle Totals	17,040	19,114	91,794	127,948

*Indicates less than 0.5 AUM.

Potential Carrying Capacity

Timberlands in Working Circle 3 carried 127,948 AUM's or 74 percent of their potential. As shown in Table 17, potential available AUM's are the amount that could be supported if every acre of grazable commercial timberland were in excellent condition. In 1978, a total of 172,277 AUM's could have been supported on sampled timberlands.

If every grazable forest acre were in excellent condition, the 1978 carrying capacity could have been increased by 44,330 AUM's. Translated into head of cattle, assuming a four month grazing season, the recommended stocking rate could have been increased from 32,000 to 43,000 head.

The potential number of AUM's depends on more than just the understory condition. Other factors, like the number of acres in each crown density group and the grazability factor, also affect the carrying capacity. Obviously, one way to increase AUM's would be to harvest enough timber so that every acre has a crown density of 0-30 percent. A more practical and realistic way to increase potential available AUM's is to increase the grazability through effective range management. Salting, herding, fencing, increasing the number of trails, increasing water developments, and reducing slash, debris, and other mechanical barriers are some of the management techniques that might be used. Properly applied, these methods will increase the amount of grazed forest land and thus the range's carrying capacity.

Table 17. Potential animal unit months (AUM's) on commercial timberland by crown density and ownership group, Working Circle 3.

Crown Density	Ownership Group			Total
	State and Other Public	Forest Industry	Other Private	
	-----AUM's-----			
0 - 30	8,211	14,784	54,686	77,681
31 - 50	9,145	6,608	47,602	63,355
51 - 70	4,357	4,608	22,276	31,242
Total	21,714	26,000	124,564	172,277

ANALYSIS OF THE TIMBER RESOURCE

In this section, maximizing timber production was used as a basis for analyzing the forest inventory data. The analysis reviews the biological condition of the commercial timberland, and assesses timber availability and the quality of the forest land for timber production. Some specific areas examined were: silvicultural treatment opportunities, stand age distribution, timberland quality classes, current growth and mortality, stocking, and the forest's biological potential for growing wood.

Forest Condition

An average acre of commercial timberland in the working circle was estimated to have the potential to produce 54 cubic feet of wood per acre per year. The average net growth per acre for softwood forest types was estimated to be 32 cubic feet per year. The mortality rate was moderate to low and was calculated to be equal to 13 percent of the total cubic foot gross growth at the time of measurement. Gross growth was estimated to be 36 cubic feet per acre per year.

State and private timberlands were dominated by low- to medium- volume sawtimber stands that had less than 10,000 board feet per acre. Sixty-three percent of the commercial timberland area contained stands ranging in age from 61 to 120 years old. It was also discovered that much of state and private timberland was not stocked properly for optimum board foot production. One analysis estimated 35 percent of the commercial timberland acreage was improperly stocked for realizing full board foot growth potential. Another analysis indicated the average acre of timberland was generally understocked, particularly with trees 9.0 inches in diameter and larger.

Growth and Mortality

Gross Growth At the time of measurement, gross growth in cubic feet per year for all growing stock softwood species was about 2.4 percent of the working circle's total cubic foot volume (see Table 18). Lodgepole pine exhibited the highest rate of growth with an annual increase in total cubic foot volume of 3.0 percent.

Table 18. Net volume, gross growth, mortality, and net growth of growing stock and sawtimber by softwood species on commercial timberland, Working Circle 3 (thousand cubic feet, thousand board feet Scribner).

	Growing Stock		Sawtimber	
	M Net Cubic Foot Volume	% of Total Cubic Foot Volume	M Net Board Foot Volume	% of Total Board Foot Volume
Douglas-fir				
Total Volume	826,323 ,	100.0	2,458,350	100.0
Gross Growth	16,527	2.0	58,293	2.4
Mortality	1,938	0.2	4,922	0.2
Net Growth	14,589	1.8	53,371	2.2
Lodgepole Pine				
Total Volume	502,947	100.0	954,283	100.0
Gross Growth	15,318	3.0	32,172	3.4
Mortality	2,330	0.5	4,041	0.4
Net Growth	12,988	2.6	28,131	2.9
Ponderosa Pine				
Total Volume	155,110	100.0	498,919	100.0
Gross Growth	3,132	2.0	11,692	2.3
Mortality	384	0.2	1,354	0.3
Net Growth	2,747	1.8	10,338	2.1
All Other Softwoods				
Total Volume	177,685	100.0	496,493	100.0
Gross Growth	5,429	3.1	10,213	2.1
Mortality	645	0.4	2,673	0.6
Net Growth	4,784	2.7	7,540	1.5
Total For All Softwoods				
Total Volume	1,662,066	100.0	4,408,044	100.0
Gross Growth	40,405	2.4	112,369	2.5
Mortality	5,297	0.3	12,989	0.3
Net Growth	35,108	2.1	99,380	2.3

Gross growth in board feet Scribner for all softwood sawtimber species was equivalent to 2.5 percent of the working circle's total board foot volume. In comparison, gross growth of softwood species in the entire Rocky Mountain region was equivalent to 2.2 percent of both the total cubic foot and board foot softwood volumes (USDA Forest Service 1978).

Most of the growth in the working circle occurred in Douglas-fir and lodgepole pine. Table 18 shows 79 percent of the cubic foot growth for all softwood species, as well as 81 percent of the board foot growth in these species, occurred in Douglas-fir and lodgepole pine.

Gross growth by diameter class data indicates smaller diameter trees grow more quickly than larger diameter trees. In other words, the growth rate decreases with age (see Tables 19 and 20). This data also shows that over half of the forest's gross growth, both in cubic feet and board feet, occurred in the two smallest diameter classes. The large amount of growth shown in the smallest diameter class is primarily caused by ingrowth.

Mortality The data collected in 1978 indicates mortality was occurring at a low to moderate rate. Mortality in softwoods, expressed as a percentage of the total softwood volume, was 0.3 percent for both cubic foot and board foot volumes. Mortality in the entire Rocky Mountain region was estimated at 0.5 percent of total volume (USDA Forest Service 1978). In 1978, mortality equalled 13 percent of the cubic foot gross growth and 12 percent of the board foot gross growth taking place in the working circle.

Tables 19 and 20 show mortality rates generally decline as diameter class increases until they reach diameters in the mid-twenties. At that point the trend reverses and mortality rates increase as the diameter class increases. Eventually mortality rates become high enough and the growth rate slow enough that the trees are dying faster than they are growing.

Table 19. Net volume, gross growth, mortality, and net growth of growing stock on commercial timberland by diameter class for softwood species, Working Circle 3 (thousand cubic feet).

Diameter Class	Volume	Gross Growth			Mortality		Net Growth	
		-----thousand cubic feet-----			-----		-----	
			%		%		%*	
5.0 - 6.9	272,092	20,470	7.5	1,108	0.4	19,362	7.1	
7.0 - 8.9	293,924	5,046	1.7	1,123	0.4	3,923	1.3	
9.0 - 10.9	278,881	4,651	1.7	896	0.3	3,755	1.3	
11.0 - 12.9	233,691	3,616	1.5	942	0.4	2,674	1.1	
13.0 - 14.9	160,641	2,287	1.4	363	0.2	1,924	1.2	
15.0 - 16.9	128,290	1,584	1.2	171	0.1	1,413	1.1	
17.0 - 18.9	93,147	1,055	1.1	28	**	1,027	1.1	
19.0 - 20.9	65,669	689	1.0	270	0.4	418	0.6	
21.0 - 22.9	45,020	412	0.9	96	0.2	317	0.7	
23.0 - 24.9	28,878	209	0.7	39	0.1	170	0.6	
25.0 - 26.9	18,853	157	0.8	79	0.4	79	0.4	
27.0 - 28.9	14,597	92	0.6	-	-	92	0.6	
29.0+	28,382	136	0.5	183	0.6	-46	-0.2	
Total	1,662,066	40,405	2.4	5,297	0.3	35,108	2.1	

*Percent of cubic foot volume for each diameter class.

**Indicates less than 0.05%.

Table 20. Net volume, gross growth, mortality, and net growth of sawtimber on commercial timberland by diameter class for softwood species, Working Circle 3 (thousand board feet Scribner).

Diameter Class	Volume	Gross Growth			Mortality		Net Growth	
		-----thousand board feet-----			-----		-----	
			%		%		%*	
9.0 - 10.9	798,393	57,879	7.2	2,965	0.4	54,914	6.9	
11.0 - 12.9	907,385	19,373	2.1	4,090	0.5	15,283	1.7	
13.0 - 14.9	690,289	12,167	1.8	1,645	0.2	10,522	1.5	
15.0 - 16.9	579,133	8,381	1.4	785	0.1	7,596	1.3	
17.0 - 18.9	434,754	5,562	1.3	128	**	5,434	1.2	
19.0 - 20.9	313,717	3,627	1.2	1,331	0.4	2,296	0.7	
21.0 - 22.9	221,858	2,157	1.0	487	0.2	1,671	0.8	
23.0 - 24.9	144,865	1,108	0.8	193	0.1	915	0.6	
25.0 - 26.9	95,485	864	0.9	400	0.4	464	0.5	
27.0 - 28.9	74,109	495	0.7	-	-	495	0.7	
29.0+	148,057	755	0.5	965	0.7	-210	-0.1	
Total	4,408,044	112,369	2.5	12,989	0.3	99,380	2.3	

*Percent of board foot volume for each diameter class.

**Indicates less than 0.05%.

The major causes of tree death in 1978 were categorized as weather, unknown, and insects (see Tables 21 and 22). Weather caused tree mortality by windthrow, snow breakage, and lightning. The category termed "unknown" was used by inventory crews when they could not determine which damaging agent was primarily responsible for killing the tree. (The inventory's mortality tree procedure allowed only one damaging agent to be recorded. Frequently the death of a tree was caused by two or more agents in concert or succession.) Mortality caused by insects was generally due to bark beetles and occasionally defoliators.

Spruce, Douglas-fir and lodgepole pine were the major victims of weather, while most of the trees killed by "unknown" factors were lodgepole pine and Douglas-fir. Because the inventory crews had limited experience at identifying root diseases, it has been suggested that much of the Douglas-fir mortality recorded as caused by weather was probably caused primarily by root rots. Mortality due to insects was highest in lodgepole pine.

Logging, fire, and disease also contributed significantly to mortality. The disease category includes various rots, rusts, and mistletoe. Logging mortality includes trees killed during the logging operation -- it does not include trees cut for harvest.

At the time of measurement, weather and insects shared dominant roles as the major causes of death in Working Circle 3. However, the causes of mortality in a forest are dynamic and cyclic, and in a future inventory the major causes of death may be different. The mountain pine beetle (Dendroctonus ponderosae Hopk.) epidemic had just begun in 1978 and has continued in various locations since that time. Lodgepole and ponderosa pine are the species that will be affected most by this epidemic.

Table 21. Net annual mortality of growing stock on commercial timberland by species and cause of death, Working Circle 3 (thousand cubic feet).

Species	Cause of Death					Total All Causes
	Insects	Disease	Fire	Animal	Weather	Suppression
					thousand cubic feet	
Douglas-fir	157	-	38	-	474	867
Lodgepole pine	405	126	105	158	446	911
Ponderosa pine	120	-	-	-	35	175
Subalpine fir	-	39	41	-	-	72
Whitebark pine*	-	-	-	-	-	-
Spruce	-	-	-	-	479	14
Western larch	-	-	-	-	-	-
Total softwoods	682	165	184	158	1,434	2,039
Aspen	-	-	-	-	16	44
Cottonwood	-	-	-	-	-	158
Total hardwoods	-	-	-	-	16	203
Total all species	682	165	184	158	1,450	2,241

Table 22. Net annual mortality of sawtimber on commercial timberland by species and cause of death, Working Circle 3 (thousand board feet Scribner).

Species	Cause of Death					Total All Causes
	Insects	Disease	Fire	Animal	Weather	Suppression
					thousand board feet	
Douglas-fir	238	-	-	-	1,596	2,636
Lodgepole pine	883	166	-	600	958	1,118
Ponderosa pine	592	-	-	-	-	607
Subalpine fir	-	141	-	-	-	262
Whitebark pine*	-	-	-	-	-	-
Spruce	-	-	-	-	2,269	-
Western larch	-	-	-	-	-	-
Total softwoods	1,713	307	-	600	4,823	4,623
Aspen	-	-	-	-	65	-
Cottonwood	-	-	-	-	-	507
Total hardwoods	-	-	-	-	65	507
Total all species	1,713	307	-	600	4,888	5,130

*May also include some limber pine.

Net Growth In 1978, net growth of softwoods was 35,108,000 cubic feet for growing stock and 99,380,000 board feet for sawtimber. This represented 2.1 percent of the softwood cubic foot volumes and 2.3 percent of the softwood board foot volume (see Tables 19 and 20). For the Rocky Mountain region, net growth for softwoods was 1.7 percent (USDA Forest Service 1978).

Over time, net growth will increase or decrease in response to changes in mortality rates, harvest rates, amounts of insects or disease, and the forest's stocking and age distribution. All of these factors can be manipulated to some degree through the management practices applied to the forest.

Potential Growth

Potential growth or yield is net growth expressed in cubic feet per acre per year as calculated by the forest inventory computation process. The estimate is based on yield tables developed for fully stocked, even-aged stands of single species. These yield tables are used to construct mean annual increment curves. Site indices derived from site trees measured on the field location are used to choose the proper mean annual increment curve. The potential cubic foot yield per acre per year is determined based on the culmination point of the mean annual increment curve. The age at the culmination point is the biological harvest age for producing the maximum amount of wood. This estimate of biological potential is considered to be less than the potential for intensively managed stands.

The average potential net growth for all forest types in Working Circle 3 was estimated to be 54 cubic feet per acre per year (see Table 23). Average gross growth per acre for softwood forest types was estimated to be 36 cubic feet per year, or about 67 percent of potential net growth. The average net growth per acre for softwood forest types was estimated to be 32 cubic feet per year, or about 59 percent of potential net growth. Nationally, net growth was 38 cubic feet per acre per year or about 51 percent of potential net growth (74 cubic feet) in 1970. Net growth for the Rocky Mountain region was estimated to be 24 cubic feet per acre per year or about 40 percent of the 60 cubic foot potential net growth (USDA Forest Service 1973).

When a forest is composed of stands in many age classes, a gap between net growth and potential net growth should be expected. However, a large gap between net growth and potential net growth may indicate management opportunities exist to increase production. Studying the forest's growth-related physical characteristics should suggest ways to reduce this gap.

Insects and Disease

Insects and disease were attacking trees on 319,000 acres or 27 percent of the commercial timberland in 1978. Both the growth (vigor) and the mortality rate of a forest are affected by the amount of insect and disease activity. Bark beetles were found on more acres than any other insect or disease problem. Diseases that cause rot were the most common problem in old-growth sawtimber stands, but bark beetles were the most common problem in all other stand size classes (see Table 24).

Table 23. Average potential productivity per acre by forest type for commercial timberland, Working Circle 3 (cubic feet/acre).

Forest Type	Average Potential Productivity (cubic feet/acre)	Net Growth (cubic feet/acre)
Douglas-fir	54.1	25.1
Lodgepole pine	59.6	66.4*
Ponderosa pine	44.1	16.0
Subalpine fir-spruce	64.5	35.8
Other softwood types	45.3	25.7
All softwood types	53.8	31.8
Aspen	57.2	26.9
Cottonwood	44.7	27.1
All hardwood types	52.1	27.0
All forest types	53.7	31.5

*This particular statistic reflects the effects of a large amount of ingrowth.

Table 24. Area of commercial timberland by stand size class and insect and disease category, Working Circle 3 (thousand acres).

Stand Size Class	Insect and Disease Category					Total
	Bark					
	Unclassified	Beetles	Defoliators	Mistletoe	Rot	
	-----thousand acres-----					
Old growth sawtimber	178.8	35.7	5.8	12.6	46.2	279.1
Young growth sawtimber	340.8	41.3	20.5	4.3	30.5	437.3
Poletimber	161.2	50.6	14.2	25.1	2.6	253.7
Seedlings and saplings	145.5	6.3	8.3	6.6	8.6	175.2
Nonstocked	<u>34.6</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>34.6</u>
Total	861.0	133.8	48.7	48.6	87.9	1,180.0

Existing Stand Structure

Distribution by Stand Size Class Sawtimber stands dominated in the working circle according to distribution by stand size class data. Sawtimber stands occurred on 61 percent of the commercial timberland acreage at the time of sampling. Only 34,600 acres, or 2.9 percent of all timberlands in the working circle, were found to be nonstocked (see Figure 7).

Distribution by Stand Age Class Distribution by stand age class data showed much of the timberland acreage to be occupied by medium aged stands. About 63 percent of the total softwood acreage -- 690,700 acres -- was covered by stands between 61 and 120 years old (see Table 25).

The other private ownership group had the largest percentage of its land occupied by young- to medium-aged stands. Seventy-four percent of the other private timberland had stands less than 101 years old.

Distribution by Stand Volume Class Most stands of timber in the working circle had low to medium amounts of board foot volume on a per acre basis. Overall, 63 percent of the commercial timberland had less than 5,000 board feet Scribner per acre. Stands in the higher volume classes, which carried at least 10,000 board feet per acre, occurred on only 159,600 acres or 14 percent of the commercial timberlands in the working circle (see Table 26).

Commercial timberlands owned by the other private ownership group contained very few high volume stands. Only 11 percent of the timberland contained 10,000 or more board feet per acre. Stands with less than 5,000 board feet per acre occurred on 68 percent of the other private ownership group's commercial timberland.

Distribution by Stocking Percent Stocking is a qualitative term used to describe the "degree of adequacy" of a stand in a particular condition to meet a certain timber management objective (Gingrich 1964). (Table 27 shows an assessment of the forest's stocking for producing board-foot volume by displaying the amount of area in each stocking percent class.) Stocking percent is the amount of space available to one live tree on a given acre compared to

Figure 7. Area of commercial timberland by stand size class, Working Circle 3 (acres).

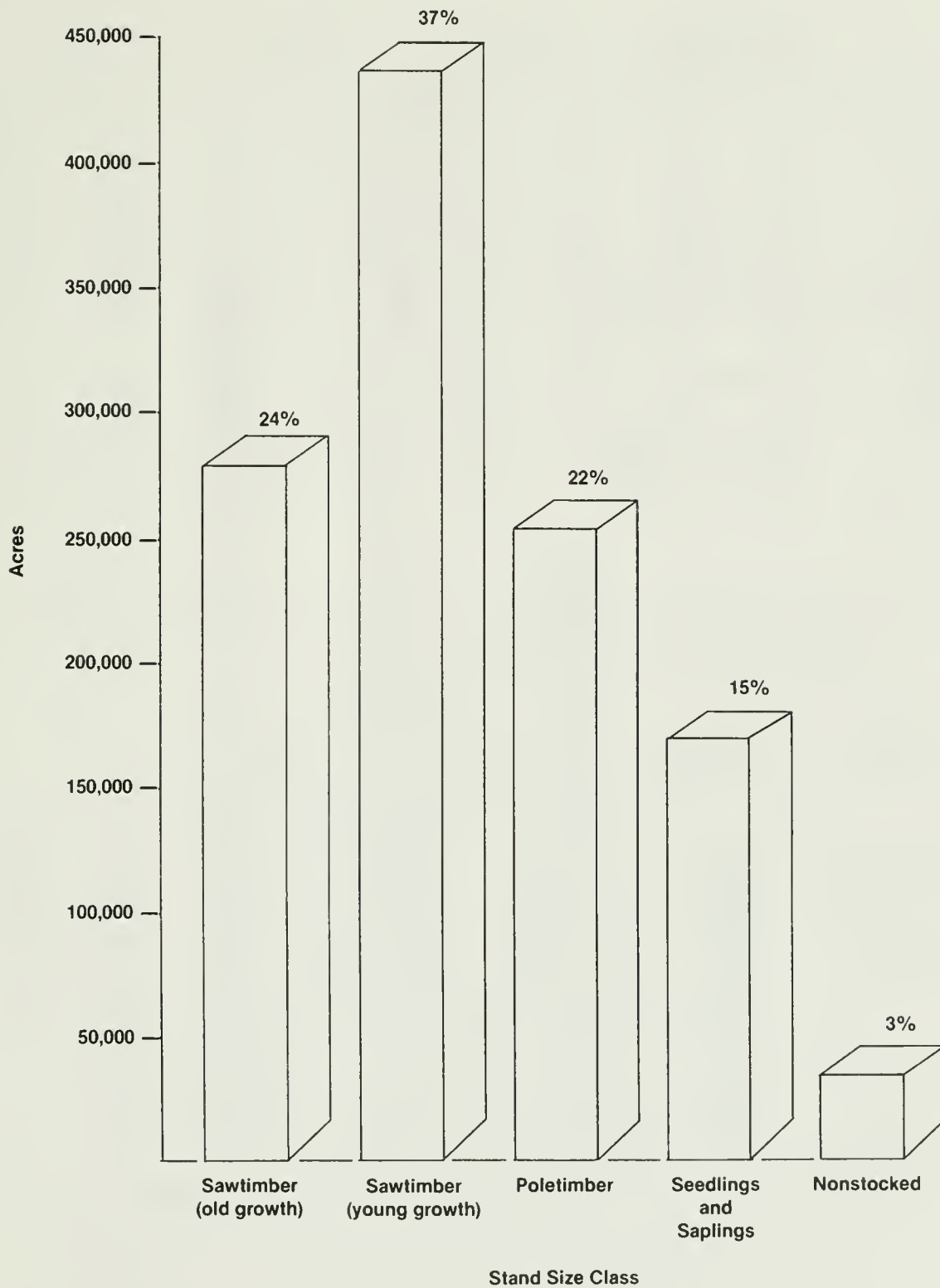


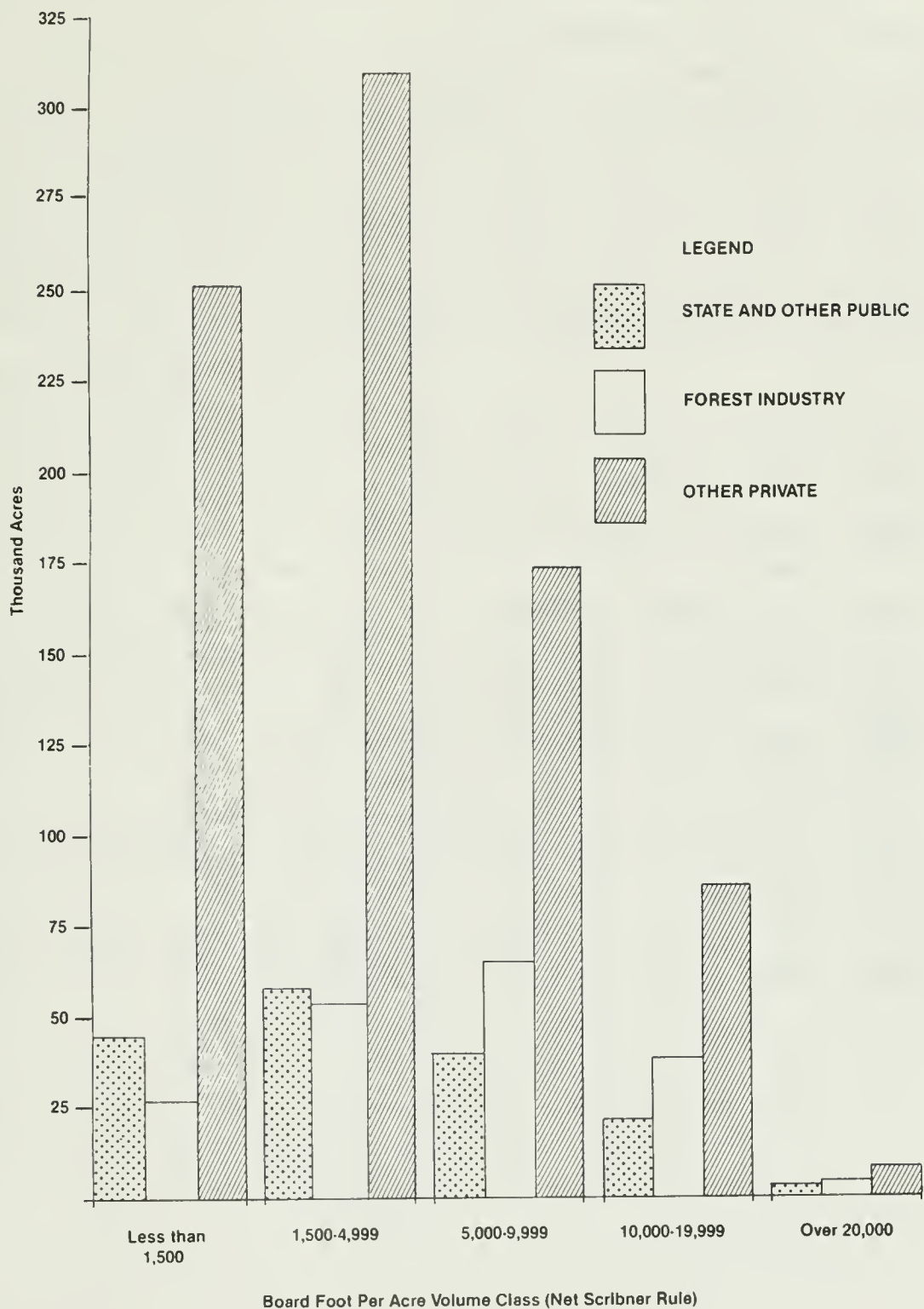
Table 25. Area of commercial softwood timberland by stand age class and ownership group, Working Circle 3 (thousand acres).

Stand Age Class	Ownership Groups							
	State and		Forest		Other		Total	
	Other Public		Industry		Private			
	-----thousand		acres-----		-----		-----	
	%		%		%		%	
Unclassified	2.6	1.7	1.8	1.0	21.9	2.9	26.3	2.4
1 - 20	3.3	2.1	6.1	3.3	27.0	3.5	36.3	3.3
21 - 40	4.5	2.9	7.4	4.1	34.5	4.5	46.4	4.2
41 - 60	16.0	10.2	7.3	4.0	70.1	9.2	93.4	8.5
61 - 80	34.7	22.1	28.3	15.5	145.3	19.0	208.2	18.9
81 - 100	44.1	28.2	41.1	22.5	268.0	35.1	353.2	32.0
101 - 120	18.6	11.8	33.5	18.4	77.3	10.1	129.3	11.7
121 - 140	10.3	6.6	10.4	5.7	37.0	4.8	57.8	5.2
141 - 160	11.9	7.6	21.7	11.9	44.3	5.8	77.9	7.1
161 - 180	5.4	3.5	12.5	6.9	13.0	1.7	31.0	2.8
181 - 200	3.3	2.1	6.6	3.6	14.2	1.9	24.1	2.2
201+	1.9	1.2	5.7	3.1	11.4	1.5	19.1	1.7
Total	156.8	100.0	182.3	100.0	763.8	100.0	1,102.9	100.0

Table 26. Area of commercial timberland by stand volume class and ownership group, Working Circle 3 (thousand acres).

Board Foot/Acre Volume Class (Net Scribner Rule)	Ownership Group							
	State and		Forest		Other		Total	
	Other Public		Industry		Private			
	-----thousand		acres-----		-----		-----	
	%		%		%		%	
Less than 1,500	44.5	26.9	26.8	14.3	250.7	30.3	322.1	27.3
1,500 - 4,999	57.7	34.9	53.6	28.7	309.3	37.4	420.6	35.7
5,000 - 9,999	39.3	23.8	64.8	34.7	173.7	21.0	277.7	23.5
10,000 - 19,999	21.1	12.8	38.0	20.3	86.2	10.4	145.4	12.3
Over 20,000	2.7	1.6	3.7	2.0	7.8	0.9	14.2	1.2
Total	165.4	100.0	186.9	100.0	827.7	100.0	1,180.0	100.0

Figure 8. Area of commercial timberland by stand volume class, Working Circle 3 (thousand acres).



the amount of space necessary for optimum yield, measured as a percentage. The amount of space needed for optimum yield depends on tree size and site quality. Consequently, the desired amount of space will vary from one sampled acre to the next (Farrenkopf 1967).

There are three stocking percent classes: less than 60 percent stocked (understocked), 60 to 132 percent stocked, and greater than 132 percent stocked (overstocked). Each field plot can be up to 167 percent stocked, since each individual sample point of the ten point cluster can be up to 16.7 percent stocked (10 points \times 16.7 percent stocking per point = 167 percent stocking per field plot), depending on the size and number of trees present. Some of the individual sample points tally more trees than required to be 16.7 percent stocked. In those instances the stocking percent remains 16.7 and will go no higher. A stocking percent class rating of 100 percent is equivalent to 60 percent of the basal area listed by a normal yield table. A normal yield table shows the maximum volume, number of trees, and basal area that a given site can support at a given age (Davis 1966). A stocking percent class rating of 132 percent is equivalent to 80 percent of the basal area listed by a normal yield table. Volume predictions made by normal yield tables are for fully stocked stands grown under "natural" conditions without competition and do not predict the yield that could be captured from a given site if managed. It is believed that a range of stocking between 60 and 100 percent of the normal yield table basal area is the range within which the full board-foot growth potential of a forest acre can be realized. Theoretically, trees in this stocking range are beginning to fully use the site and growth per acre is not reduced by overcrowding.

Table 27 shows that at the time of sampling about 35 percent of the commercial timberland in Working Circle 3 was improperly stocked for realizing its full board foot growth potential. Approximately 250,500 acres were understocked and 165,700 acres were overstocked. Many of the overstocked pole-timber and seedling-sapling stands, jointly covering about 103,500 acres, represent potential thinning opportunities. In the future, some of the medium stocked and understocked stands may also require thinning before they become sawtimber stands.

Table 27. Area of commercial timberland by ownership group, stand size class, and stocking percent class, Working Circle 3 (thousand acres).

	Stocking Percent Class							
	59 or less (understocked)		60-132		133 or more (overstocked)		Total	
	-----thousand acres-----							
	%		%		%		%	
State and Other Public								
Old growth sawtimber	3.6	2.2	32.5	19.7	5.3	3.2	41.4	25.0
Young growth sawtimber	11.8	7.1	40.7	24.6	5.5	3.3	58.0	35.1
Poletimber	3.1	1.9	22.9	13.8	14.2	8.6	40.2	24.3
Seedlings and saplings	4.6	2.8	13.6	8.2	3.8	2.3	22.0	13.3
Nonstocked	3.7	2.3	-	-	-	-	3.7	2.3
Totals	26.9	16.3	109.7	66.3	28.8	17.4	165.4	100.0
Forest Industry								
Old growth sawtimber	14.4	7.7	54.0	28.9	9.4	5.0	77.7	41.6
Young growth sawtimber	13.0	6.9	31.6	16.9	8.7	4.6	53.3	28.5
Poletimber	0.3	0.1	15.3	8.2	15.1	8.1	30.7	16.4
Seedlings and saplings	10.4	5.6	11.0	5.9	1.8	1.0	23.2	12.4
Nonstocked	2.0	1.1	-	-	-	-	2.0	1.1
Totals	40.0	21.4	111.9	59.9	35.0	18.7	186.9	100.0
Other Private								
Old growth sawtimber	22.3	2.7	120.7	14.6	17.0	2.0	160.0	19.3
Young growth sawtimber	80.4	9.7	229.3	27.7	16.3	2.0	325.9	39.4
Poletimber	19.4	2.3	108.9	13.2	54.5	6.6	182.8	22.1
Seedlings and saplings	32.6	3.9	83.3	10.1	14.2	1.7	130.0	15.7
Nonstocked	28.9	3.5	-	-	-	-	28.9	3.5
Totals	183.6	22.1	542.2	65.6	101.9	12.3	827.7	100.0
Working Circle Total								
Old growth sawtimber	40.3	3.4	207.2	17.6	31.6	2.7	279.1	23.7
Young growth sawtimber	105.2	8.9	301.6	25.6	30.5	2.6	437.3	37.1
Poletimber	22.8	1.9	147.1	12.5	83.8	7.1	253.7	21.5
Seedlings and saplings	47.6	4.0	107.9	9.1	19.7	1.7	175.2	14.8
Nonstocked	34.6	2.9	-	-	-	-	34.6	2.9
Totals	250.5	21.1	763.8	64.8	165.7	14.1	1,180.0	100.0

Basal Area by Diameter Class The basal area by diameter class for the average acre of commercial softwood forest land in 1978 is displayed by productivity class in Figures 10 and 11. The average basal area per acre was lower on the 20-49 site class timberlands than on the more productive timberlands.

Figure 9 shows the expected basal area per acre by diameter class curve for an average acre of forest land if the forest land base were brought under full management and were fully regulated. The shape of the desired curve is based on a theoretical situation where the forest is fully regulated and a variety of round-wood materials (pulp, poles, and saw logs) are product objectives (Green 1976). When regulated, the forest would consist of many individual stands of trees with different ages and sizes. All of these different stands, viewed as one, would give the appearance of a forest managed by the selection method. The basal area in trees less than 10 inches d.b.h. should be about 40 percent of the basal area in trees 10 inches d.b.h. and larger, or about 30 percent of the total basal area (Green 1976). The desired amount of basal area stocking under the curve is the average level of stocking which should be carried over the life of the stand. Under intensive management, the stand would be allowed to grow to a higher basal area per acre stocking level than desired. It then would be thinned back to a level below the desired stocking level. This process might be repeated several times until the stand is finally harvested. Under an uneven-aged management scheme, certain trees in a stand would be harvested on a periodic basis but the desired average basal area per acre would still be maintained.

The percent of total basal area per acre below the 10-inch diameter class at the time of sampling was 50 percent for the 20-49 site class timberlands and 44 percent for the 50 plus site class timberlands. At first glance, the percentage of basal area below the 10-inch diameter class would indicate thinning is needed to balance out the diameter distribution on the privately owned lower site land. This would probably be true if the average acre were stocked at or above the desired amount. However, this does not appear to be the case when the average stand age, site class, and forest type composition of the forest represented by each curve are taken into account. All the sites appear to be understocked, especially when compared to basal area stan-

dard tables.* The degree to which these sites are understocked varies according to the management regime which is chosen based on the objectives of the land owner or manager.

If the average forest acre is understocked, the average amount of basal area per acre may actually be low for all owners on all site classes. Thinning opportunities would still be available, but at a level below the initial estimate. Evidence of understocking would indicate that there are areas where stocking needs to be increased by natural or artificial regeneration if higher yields are desired.

The graphs in Figures 10 and 11 represent a one-point-in-time picture of the average basal area per acre by diameter class. The key to developing timber management strategies based on these graphs is to know the direction and rate of change occurring within each diameter class. Estimates concerning the changes or dynamics of the forest can best be made by analyzing remeasurement data. Unfortunately, such data is not available at this time.

*For example, according to basal area standard tables for ponderosa pine (derived from USDA Technical Bulletin No. 630, 1934), 80-year-old stands on MAI sites of 30 cubic feet per acre per year should have a basal area stocking of 93 square feet per acre. Ninety-year-old stands on MAI sites of 60 cubic feet per acre per year should have a basal area stocking of 135 square feet per acre.

Figure 9. Example of the shape of the desired average basal area per acre by diameter class curve, providing a variety of round-wood materials are product objectives. The amount of basal area depicted by the curve is depended on the management regime and the productivity of the land to produce wood.

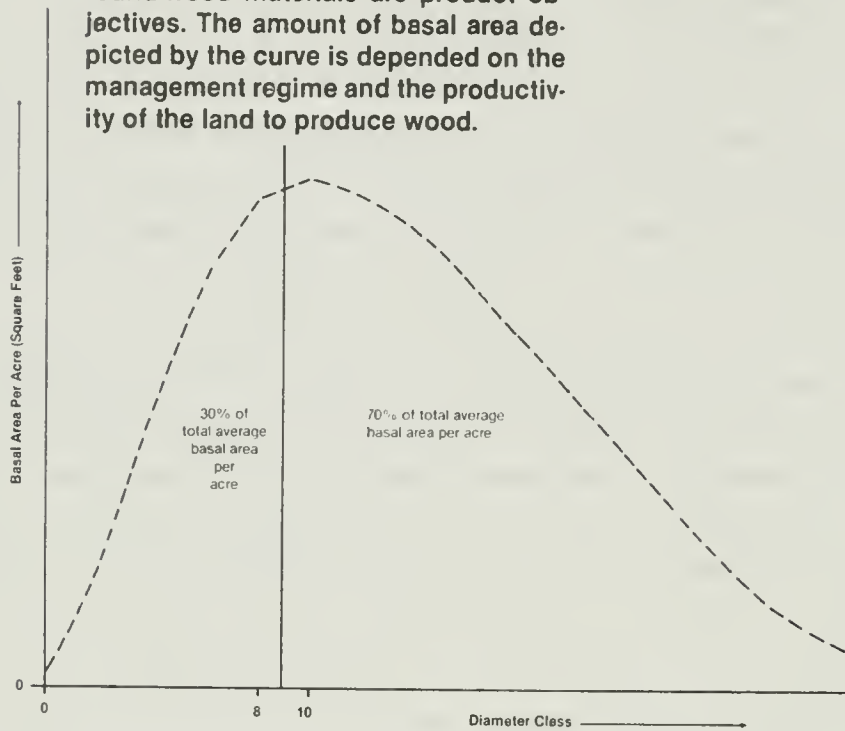


Figure 10. Current average basal area per acre for softwoods by diameter class, MAI site class 20-49, Working Circle 3.

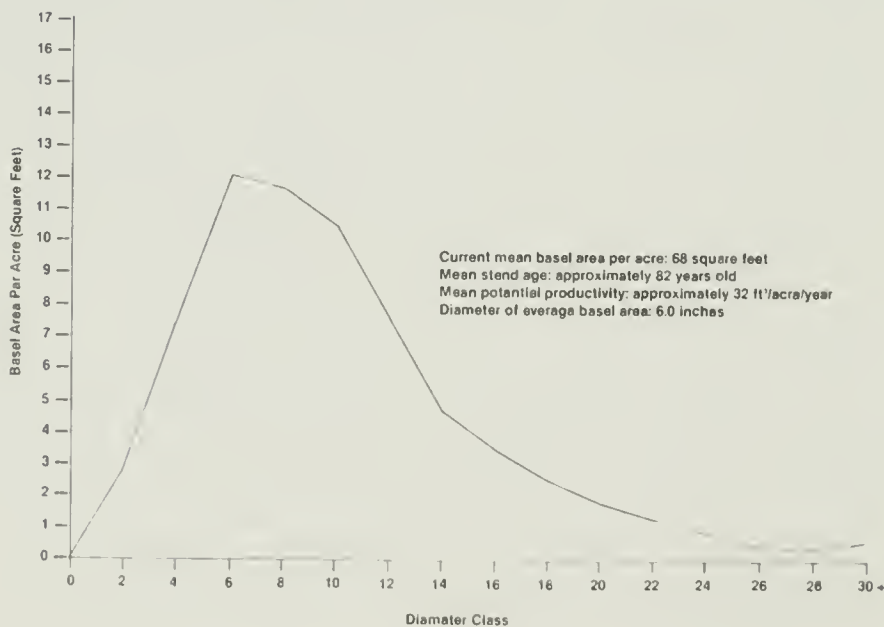
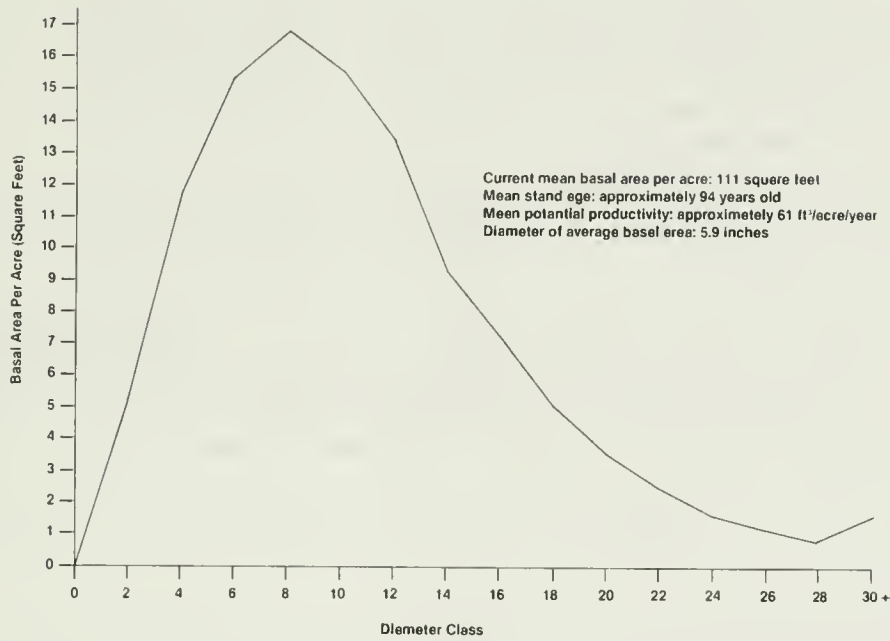


Figure 11. Current average basal area per acre for softwoods by diameter class, MAI site class 50 + , Working Circle 3.



Timberland Quality Class

Approximately 440,100 acres, or 40 percent, of the commercial softwood timberland in the working circle was rated as good or excellent for timber production based on a classification system developed for Montana. The forest industry ownership group had 54 percent of its timberland rated as excellent or good, the greatest amount among ownership groups on a percentage basis. The other private ownership had the most acreage rated as good or excellent among the three major ownership groups.

Timberland quality classes in this analysis are used to rate commercial timberlands according to their relative value for producing timber. The rankings are based primarily on factors that indicate the operability and productivity of the forest. Four quality classes -- excellent, good, fair, and poor -- were used. To avoid confusing the findings of this timberland rating effort with those of other state and federal land management agencies, the term "prime timberlands" was not used.

Class Definitions

The criteria used to place timberlands into the appropriate quality classes are as follows:

Excellent timberlands

- have a potential productivity that is greater than or equal to 85 cubic feet per acre per year;
- have a slope that is less than or equal to 40 percent;
- have a good (class I) or medium (class II) landscape stability rating;
- are less than or equal to 7,000 feet in elevation west of the Continental Divide and less than or equal to 8,000 feet east of the Divide.

Good timberlands

- do not meet the requirements for excellent timberlands;
- have a potential productivity that is greater than or equal to 50 cubic feet per acre per year;
- have a good (class I) or medium (class II) landscape stability rating;
- have a slope that is less than or equal to 40 percent if potential productivity is less than 85 cubic feet per acre per year;

-- are less than or equal to 7,000 feet in elevation west of the Continental Divide and less than or equal to 8,000 feet east of the Divide.

Fair timberlands

-- do not meet the requirements for good or excellent timberlands;
-- have a potential productivity that is greater than or equal to 20 cubic feet per acre per year;
-- have a slope that is less than or equal to 56 percent;
-- have a good (class I) or medium (class II) landscape stability rating;
-- are less than or equal to 8,000 feet in elevation.

Poor timberlands

-- do not meet the requirements for excellent, good, or fair timberlands.

Timberland Quality Class and Stand Size Class

About 40 percent, or 440,100 acres, of the commercial softwood timberland in the working circle was rated as good or excellent for timber production. Fifty-four percent of the young-growth sawtimber stands and 31 percent of the old-growth sawtimber stands were found on good or excellent rated timberlands. An estimated 114,500 acres or 60 percent of seedling-sapling and nonstocked stands were found on timberland rated as fair for timber production (see Figure 12).

Timberland Quality Class by Ownership Group

Fifty-four percent of the commercial softwood timberlands owned by forest industries were rated as excellent or good. This compared favorably to the relative amounts of excellent and good rated timberland found on the other two ownership groups. State and other public had 40 percent of their timberlands rated as excellent or good. The other private ownership group had 37 percent.

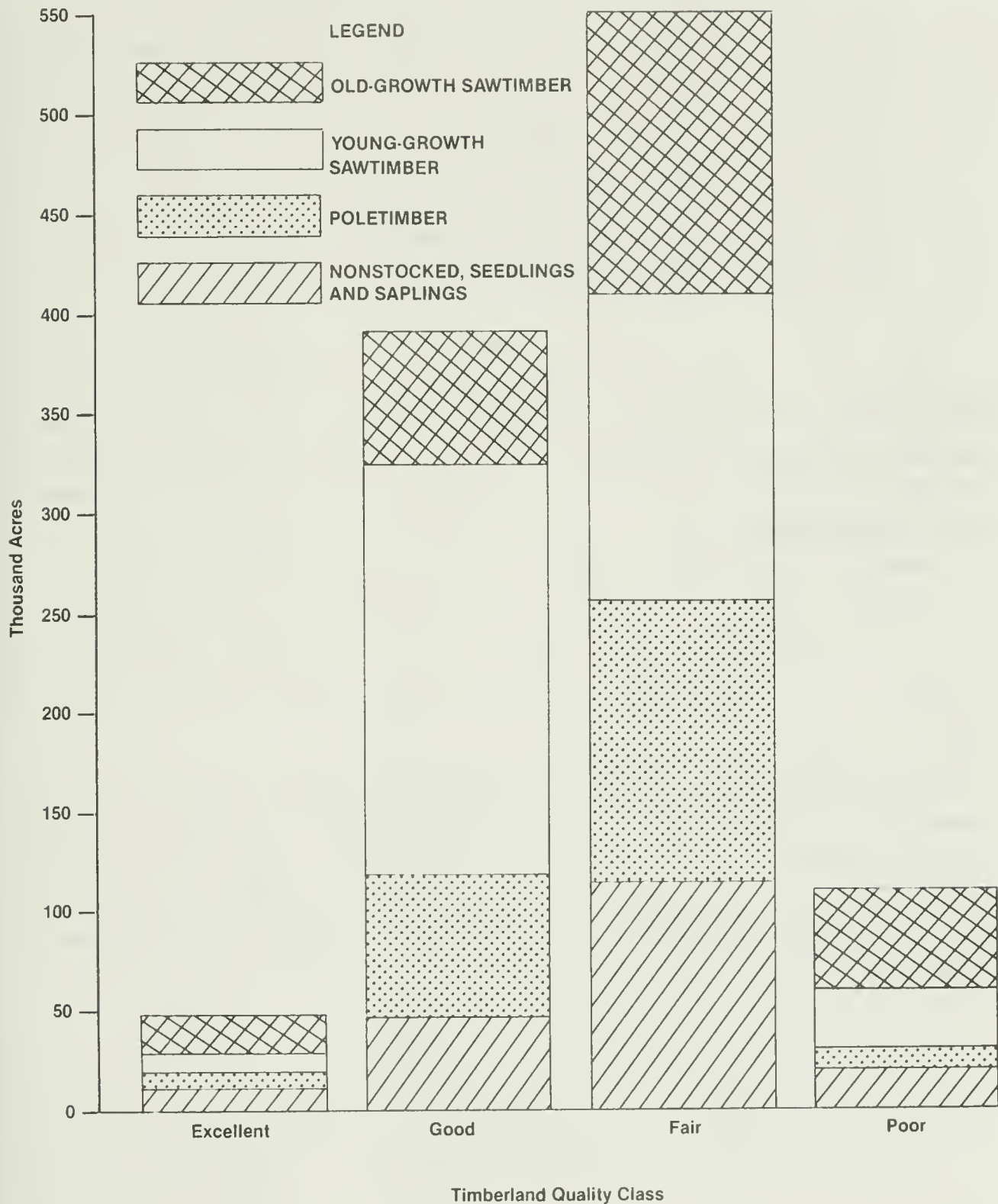
However, if total acreage by ownership group is examined, most of the excellent and good rated timberland in the working circle (64 percent) is owned by the other private group (see Table 28).

Table 28. Area of commercial softwood timberland by ownership group, stand size class, and timberland quality class, Working Circle 3 (thousand acres).

Ownership Group	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
State and Other Public	-----thousand acres-----				
Stand Size Class					
Old growth sawtimber	3.3	11.0	20.7	6.4	41.4
Young growth sawtimber	2.3	26.5	20.8	3.6	53.3
Poletimber	1.5	11.0	23.8	1.4	37.7
Seedlings and saplings	0.9	5.6	13.7	1.6	21.7
Nonstocked	0.2	0.5	1.8	0.1	2.6
Total	8.2	54.6	80.8	13.2	156.8
Forest Industry					
Stand Size Class					
Old growth sawtimber	10.0	18.8	30.3	18.6	77.7
Young growth sawtimber	1.4	40.3	4.9	4.8	51.5
Poletimber	1.1	17.1	11.9	0.5	30.6
Seedlings and saplings	*	8.5	7.9	4.3	20.7
Nonstocked	0.2	*	1.6	-	1.8
Total	12.6	84.8	56.7	28.3	182.3
Other Private					
Stand Size Class					
Old growth sawtimber	7.1	36.6	90.0	26.4	160.0
Young growth sawtimber	4.8	139.4	128.2	20.6	293.0
Poletimber	5.9	44.6	106.3	9.0	165.8
Seedlings and saplings	5.5	28.9	78.3	10.4	123.1
Nonstocked	4.2	2.9	11.2	3.5	21.9
Total	27.5	252.4	414.0	69.9	763.8
Working Circle Totals					
Stand Size Class					
Old growth sawtimber	20.3	66.4	141.0	51.5	279.1
Young growth sawtimber	8.5	206.2	154.0	29.1	397.8
Poletimber	8.5	72.7	141.9	11.0	234.1
Seedlings and saplings	6.4	43.0	99.9	16.3	165.6
Nonstocked	4.6	3.5	14.6	3.6	26.3
Total	48.3	391.8	551.4	111.4	1,102.9

*Indicates less than 50 acres.

Figure 12. Area of commercial softwood timberland by stand size class and timberland quality class, Working Circle 3.



Silvicultural Treatment Opportunities

The DSL, Forestry Division, developed a procedure to analyze data recorded on the field location that would place the sampled stand into one of several categories. Each of these categories represented a set of silvicultural treatment opportunities. As a result of this analysis it was determined that 60 percent of the commercial timberland offered silvicultural treatment opportunities to improve the forest's condition and ultimately increase timber yields. An estimated 540,200 acres, or 49 percent of the commercial softwood timberland, were placed into categories that imply silvicultural treatment opportunities other than harvest are available. When silvicultural treatment opportunity by timberland quality class was investigated it was discovered that the leading individual treatment opportunities existing on excellent and good timberlands were: harvest - low risk (90,900 acres), overstory removal (85,800 acres), precommercial thinning (73,100 acres), harvest - high risk (72,200 acres), and no treatment due to productive condition (65,900 acres).

The Forestry Division has developed a procedure for using forest inventory data to assess silvicultural treatment opportunities. As a part of this procedure, 12 treatment opportunity categories were selected, each representing a group of stands with similar characteristics. Each category was given a treatment code number and a treatment name, such as "20 - Pre-commercial thinning."

Despite its appearance, a treatment name does not prescribe a treatment -- it is merely a label for a group of stands that exhibit common characteristics. These characteristics differentiate one group of stands from another. Although these labels have a silvicultural basis, the limited amount of stand data used to derive these categories restricts the use of the process to planning.

To some degree, the treatment names used here reflect the forest management policies of the Forestry Division since different stand conditions and forestry goals demand different management techniques. Other forest managers might apply different names to these categories, or possibly combine two or more of them under a single heading, depending on their management objectives.

Treatment Code Definitions

Table 29 lists the treatment opportunities and their code numbers. The list is divided into three groups. The first consists of the individual treatments, the other two list possible combined treatments, which are of two types: those that do not overlap and those that may. The combined codes listed under the "possible overlap" group represent treatments that may overlap each other during actual treatment. For example, the combined treatment code 13, 20, 22 suggests that a certain stand needs a treatment, or treatments, that will remove the overstory (13), precommercially thin (20), and sanitize the stand (22). Two or more of these needs might be met in one step. Sanitation may be partially met by precommercial thinning, or it may be partially or completely met by removing the overstory.

Understanding that some treatments may be handled simultaneously is important when allocating funds, equipment, and manpower for timber stand improvement projects. Estimates of costs and work loads may be reduced for acreages on which treatments may overlap.

For further information about the kinds of stands represented by each treatment code, see Appendix 5.

Treatment Opportunities by Ownership Group and Site Class

Five codes indicate no immediate treatments are needed. These are: (11) and (15) harvest - low risk, (30) no treatment due to productive condition, (33) no treatment - deferred until merchantable, and (40) unknown - poor crowns, good growth. In Working Circle 3, approximately 354,800 acres, or about 32 percent of the commercial softwood timberlands, were placed into these treatment categories (see Table 30). An additional 207,900 acres were placed into harvest - high risk. The remaining 540,200 acres, or 49 percent of the commercial softwood timberlands, were placed into categories that imply silvicultural treatment opportunities are available. If stands in the harvest - high risk category (10) and (14) are added, the total amount of commercial softwood timberland that could use some type of silvicultural treatment becomes 748,100 acres, or 68 percent of all softwood timberlands inventoried.

This does not mean that all of these acres should be treated. Because of the costs involved and possible nontimber resource considerations, it may not be advisable to apply the indicated treatments to some stands. Nevertheless, this total acreage figure is important because it helps to illustrate the overall condition of the forest. It also partially explains why current net growth in the working circle averages 22 cubic feet per acre per year less than potential net growth. These opportunities can be viewed with optimism if forest managers plan to take advantage of them to increase the health and vigor (productivity) of the forest.

If lands in the harvest - high risk categories (10) and (14) are subtracted from the total number of acres offering silvicultural treatment opportunities, an estimate of the number of acres offering treatment opportunities other than harvesting can be made. Such a calculation shows some real differences in the relative amounts of treatment opportunities by ownership. Forest industry owned timberland had the least amount of acreage offering treatment opportunities other than harvest 57,800 acres or 32 percent of the ownership group's commercial timberland. State and other public lands had 68,800 acres or 44 percent. The other private ownership group showed the highest amount of silvicultural treatment opportunities other than harvest with 413,900 acres or 54 percent of the commercial timberland in the ownership. See Table 68 in Appendix 3.

Table 29. Treatment opportunity code definitions for Tables 30 and 31.

10	Harvest - high risk
11	Harvest - low risk
12	Commercial thinning
13	Overstory removal
14	Two storied stand (overstory, harvest - high risk; understory, manageable)
15	Two storied stand (overstory, harvest - low risk; understory, manageable)
20	Precommercial thinning
21	Stand conversion
22	Sanitation
23	Regeneration of understocked areas
30	No treatment due to productive condition
32	No treatment - inoperable
33	No treatment - deferred until merchantable
40	Unknown - poor crowns, good growth

No Overlap

12, 13	Commercial thinning, overstory removal
13, 20	Overstory removal, precommercial thinning
13, 20, 23	Overstory removal, precommercial thinning, regeneration of understocked areas
13, 21	Overstory removal, stand conversion
13, 23	Overstory removal, regeneration of understocked areas
13, 33	Overstory removal, no treatment - deferred until merchantable
20, 23	Precommercial thinning, regeneration of understocked areas
22, 23	Sanitation, regeneration of understocked areas
22, 33	Sanitation, no treatment - deferred until merchantable

Possible Overlap

12, 13, 22	Commercial thinning, overstory removal, sanitation
12, 22	Commercial thinning, sanitation
13, 20, 22	Overstory removal, precommercial thinning, sanitation
13, 20, 22, 23	Overstory removal, precommercial thinning, sanitation, regeneration of understocked areas
13, 22	Overstory removal, sanitation
13, 22, 23	Overstory removal, sanitation, regeneration of understocked areas
13, 22, 33	Overstory removal, sanitation, no treatment - deferred until merchantable
20, 22	Precommercial thinning, sanitation
20, 22, 23	Precommercial thinning, sanitation, regeneration of understocked areas

Table 30. Area of commercial softwood timberland by treatment opportunity group and MAI site class, Working Circle 3 (thousand acres).

Treatment Opportunity Group	Site Class (Ft ³ /acre/year)					All Classes
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
10	79.1	104.8	4.6	3.5	-	192.1
11	50.8	95.8	23.3	0.9	-	170.8
12	-	3.5	-	-	-	3.5
13	21.5	32.6	-	-	-	54.1
14	11.5	4.3	-	-	-	15.8
15	-	-	-	-	-	-
20	75.5	36.8	5.9	0.4	-	118.7
21	3.6	28.9	5.6	-	-	38.1
22	24.2	18.8	1.8	-	-	44.8
23	92.7	13.2	5.6	-	-	111.6
30	62.7	87.5	10.7	3.5	-	164.5
32	3.6	-	-	-	-	3.6
33	-	3.6	3.6	-	-	7.3
40	-	12.2	-	-	-	12.2
12, 13	-	-	-	-	-	-
13, 20	6.0	11.3	-	-	-	17.3
13, 20, 23	-	3.5	-	-	-	3.5
13, 21	6.3	7.2	-	-	-	13.6
13, 23	12.7	14.4	-	-	-	27.1
13, 33	-	7.4	-	-	-	7.4
20, 23	7.3	5.7	-	-	-	13.0
22, 23	7.3	-	-	-	-	7.3
22, 33	0.4	-	-	-	-	0.4
12, 13, 22	-	-	-	-	-	-
12, 22	-	-	-	-	-	-
13, 20, 22	14.6	14.4	-	-	-	29.0
13, 20, 22, 23	3.6	-	-	-	-	3.6
13, 22	7.4	7.1	-	-	-	14.5
13, 22, 23	-	1.0	-	-	-	1.0
13, 22, 33	-	3.7	-	-	-	3.7
20, 22	18.4	4.7	-	-	-	23.1
20, 22, 23	-	-	1.2	-	-	1.2
Total	509.2	522.8	62.5	8.3	-	1,102.9

Silvicultural Treatment Opportunities by Timberland Quality Class

Forest managers usually consider a stand's potential economic return before applying silvicultural treatments. Potential productivity and operability of the land are important factors in determining the possible economic return realized from forest management activities. Therefore, a table that estimates acreage by timberland quality class and treatment opportunity class can be helpful by showing how many acres are likely to be economical to treat. Obviously, timber management funds are more likely to be spent on timberlands rated as good or excellent than on timberlands of lesser quality. The amounts of land in the different timberland quality classes that were assigned to the different treatment opportunities are shown in Tables 31 and 32. These acreages are shown for the working circle as a whole, as well as for the different ownership groups.

In Working Circle 3, the treatment opportunity with the largest amount of good or excellent quality timberland at the time of measurement was harvest - low risk. This treatment opportunity existed on 90,900 acres of these more productive lands. The category with the second highest amount of acreage was harvest - high risk (codes 10 and 14) with 72,200 acres.

As shown in Table 31, large amounts of high quality timberland also fell into four other treatment opportunity categories:

- 30 - No treatment due to productive condition (65,900 acres)
- 20 - Precommercial thinning (38,400 acres)
- 13 - Overstory removal (32,600 acres)
- 21 - Stand conversion (27,700 acres)

Another way to view treatment opportunities is to break the combined treatment codes into their component treatment codes and assign each code the total acreage figure. For example, if 10,000 acres are assigned the "13, 20 - overstory removal and precommercial thinning" combined treatment code, then 10,000 acres present opportunities for overstory removal and 10,000 acres present opportunities for precommercial thinning. By adding the acreages assigned to the individual codes it is possible to determine the amount of land offering opportunities for each type of treatment. Table 32 shows the total number of acres assigned to each treatment opportunity class. The tab-

Table 31. Area of commercial softwood timberland by treatment opportunity group and timberland quality class, Working Circle 3 (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	4.5	63.4	91.3	32.9	192.1
11	20.6	70.3	45.1	34.7	170.8
12	-	3.5	-	-	3.5
13	-	32.6	19.1	2.4	54.1
14	-	4.3	11.5	-	15.8
15	-	-	-	-	-
20	6.4	32.0	78.0	2.3	118.7
21	5.6	22.1	8.0	2.4	38.1
22	1.8	15.4	27.6	-	44.8
23	1.0	9.9	92.2	8.4	111.6
30	7.1	58.8	86.1	12.4	164.5
32	-	-	-	3.6	3.6
33	-	3.6	3.6	-	7.3
40	-	12.2	-	-	12.2
12, 13	-	-	-	-	-
13, 20	-	5.2	9.6	2.4	17.3
13, 20, 23	-	3.5	-	-	3.5
13, 21	-	7.2	3.8	2.6	13.6
13, 23	-	7.4	12.7	7.1	27.1
13, 33	-	3.8	3.6	-	7.4
20, 23	-	5.7	7.3	-	13.0
22, 23	-	-	7.3	-	7.3
22, 33	-	-	0.4	-	0.4
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	-	14.4	14.6	-	29.0
13, 20, 22, 23	-	-	3.6	-	3.6
13, 22	-	7.1	7.4	-	14.5
13, 22, 23	-	1.0	-	-	1.0
13, 22, 33	-	3.7	-	-	3.7
20, 22	-	4.7	18.4	-	23.1
20, 22, 23	<u>1.2</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1.2</u>
Total	48.3	391.8	551.4	111.4	1,102.9

le also shows the amounts of land in the different timberland quality classes that were assigned to the different treatment opportunity classes (see Table 32).

Because they are not combined with any other treatments, the number of acres in the harvest - high risk and harvest - low risk groups does not change in the treatment class tables. If these "harvest" groups are ignored, the most commonly assigned treatment opportunity classes for excellent and good-rated timberlands in Working Circle 3 were overstory removal (85,800 acres), precommercial thinning (73,100 acres), no treatment due to productive condition (65,900 acres), and sanitation (49,400).

Table 32. Area of commercial softwood timberland by ownership group, treatment class, and timberland quality class, Working Circle 3 (thousand and acres).

Treatment Class	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest - high risk	1.0	11.3	11.7	3.1	27.1
Harvest - low risk	3.8	11.8	9.0	5.2	29.9
Commercial thinning	-	0.5	-	-	0.5
Overstory removal	-	7.7	9.6	0.7	17.9
Two storied stand:	-	1.0	3.4	-	4.4
Overstory, harvest - high risk					
Understory, manageable					
Two storied stand:	-	-	-	-	-
Overstory, harvest - high risk					
Understory, manageable					
Precommercial thinning	0.9	6.9	18.7	0.6	27.0
Stand conversion	1.0	3.8	1.6	0.1	6.5
Sanitation	0.2	6.8	11.2	-	18.2
Regeneration of understocked areas	0.1	3.1	14.1	1.1	18.4
No treatment due to productive condition	1.2	8.9	13.1	2.5	25.8
No treatment - inoperable	-	-	-	0.4	0.4
No treatment - deferred until merchantable	-	1.1	1.3	-	2.5
Unknown - poor crowns, good growth	-	0.3	-	-	0.3

Table 32.

(page 2)

Forest Industry

Timberland Quality Class

Treatment Class	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest - high risk	3.5	20.5	17.5	12.8	54.3
Harvest - low risk	2.9	6.5	10.0	10.3	29.7
Commercial thinning	-	*	-	-	*
Overstory removal	-	14.3	3.0	2.5	19.8
Two storied stand:	-	3.4	0.8	-	4.1
Overstory, harvest - high risk					
Understory, manageable					
Two storied stand:	-	-	-	-	-
Overstory, harvest - low risk					
Understory, manageable					
Precommercial thinning	1.3	15.7	4.3	2.5	23.8
Stand conversion	1.1	4.1	0.2	-	5.4
Sanitation	1.4	6.4	2.2	-	9.9
Regeneration of understocked areas	1.4	8.5	12.0	1.2	23.1
No treatment due to productive condition	3.5	18.6	10.5	1.4	34.0
No treatment - inoperable	-	-	-	*	*
No treatment - deferred until merchantable	-	0.1	*	-	0.1
Unknown - poor crowns, good growth	-	2.4	-	-	2.4

Other Private

Timberland Quality Class

Treatment Class	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest - high risk	-	31.6	62.1	17.0	110.6
Harvest - low risk	13.9	52.0	26.2	19.1	111.2
Commercial thinning	-	2.9	-	-	2.9
Overstory removal	-	63.9	61.9	11.3	137.1
Two storied stand:	-	-	7.3	-	7.3
Overstory, harvest - high risk					
Understory, manageable					
Two storied stand:	-	-	-	-	-
Overstory, harvest - low risk					
Understory, manageable					
Precommercial thinning	5.5	42.9	108.6	1.7	158.6
Stand conversion	3.5	21.4	10.0	4.9	39.8
Sanitation	1.5	33.1	66.0	-	100.6
Regeneration of understocked areas	0.7	16.0	97.0	13.2	126.9
No treatment due to productive condition	2.4	31.3	62.5	8.5	104.7
No treatment - inoperable	-	-	-	3.2	3.2
No treatment - deferred until merchantable	-	9.8	6.4	-	16.2
Unknown - poor crowns, good growth	-	9.4	-	-	9.4

*Indicates less than 50 acres.

Table 32.

(page 3)

Working Circle Total

Timberland Quality Class

Treatment Class	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
Harvest - high risk	4.5	63.4	91.3	32.9	192.1
Harvest - low risk	20.6	70.3	45.1	34.7	170.8
Commercial thinning	-	3.5	-	-	3.5
Overstory removal	-	85.8	74.5	14.5	174.8
Two storied stand:	-	4.3	11.5	-	15.8
Overstory, harvest - high risk					
Understory, manageable					
Two storied stand:	-	-	-	-	-
Overstory, harvest - low risk					
Understory, manageable					
Precommercial thinning	7.6	65.5	131.5	4.8	209.5
Stand conversion	5.6	29.3	11.8	5.0	51.7
Sanitation	3.1	46.3	79.3	-	128.7
Regeneration of understocked areas	2.3	27.5	123.1	15.5	168.4
No treatment due to productive condition	7.1	58.8	86.1	12.4	164.5
No treatment - inoperable	-	-	-	3.6	3.6
No treatment - deferred until merchantable	-	11.1	7.7	-	18.8
Unknown - poor crowns, good growth	-	12.2	-	-	12.2

Available Timber

An analysis of timber availability based on many of the factors that affect timber management shows timber yields in Working Circle 3 may be reduced by 16 percent due to nontimber use constraints.

A difficult and potentially expensive task in any forest inventory is determining the amount of timber that is actually available for harvesting. Every acre of state and private forest land is not available for continuous timber harvesting and probably never will be unless wood becomes much more valuable.

The first step in assessing timber availability is to group the forest land into availability classes. This is done based on various combinations of land use influence zones, ownership groups, and topographic characteristics. Some of the criteria used to delineate availability classes include water influence zones, travel influence zones, slope percent, and elevation. These availability classes are then assigned to one of three land classes based on each land class's definition and the characteristics of the different availability classes. Table 33 shows the criteria used to assess timber availability in Working Circle 3.

Land Classes

The commercial forest land in Working Circle 3 was grouped into three land classes (Green 1976):

1. Standard: land available and operable now that is not subject to any nontimber use impacts that might affect timber growing costs or expected yields;
2. Special: land available and operable now, but with ecological or other use constraints that might affect the cost of growing timber, expected yield, or both; and
3. Marginal: land potentially available and operable, or both, but not now expected to be harvested because of excessive development costs, low product returns, or resource protection constraints.

Availability Classes

An availability class was designated for the different types of land included in each land class. Using standard land as Availability Class I, where full yields can be expected to be available, other availability classes were defined as a percentage of the standard land yields expected, considering the impacts of other uses.

In this manner, it was possible to estimate the amount that timber yields would be reduced because of nontimber use constraints. For Working Circle 3, this amount proved to be equivalent to reducing the commercial forest land area by 16 percent.

Table 34 shows the amount of land in each land class.

Table 33. Availability class definitions and components.

<u>Land Class</u>	<u>Availability Class</u>	<u>% of Standard Land Yield Expected</u>	<u>Definition</u>
Standard	I	100	Standard land definition
Special	I	100	Big game winter range
Special	II	90	Travel and municipal influence zone
Special	III	75	Ski resort, recreation, and subdivision influence zones
Special	IV	50	Water influence zones and other private individual owner
Special	V	0	Subdivided land, State Department of Fish, Wildlife and Parks land, and miscellaneous Federal land
Marginal	IV	50	Steep slopes (greater than 64%), all land greater than 8,000 feet in elevation, and all land that has a landscape stability class rating of III (Stability data available only west of Divide)

Table 34. Area of commercial timberland by availability class, productivity class, and land class, Working Circle 3 (thousand acres).

Availability Class	Productivity Class Ft³/Acre/Year	Land Class			
		Standard	Special	Marginal	Total
		-----thousand acres-----			
I	20 - 49	153.2	173.3	-	326.5
	50 - 84	181.1	162.2	-	343.3
	85 - 119	26.5	21.8	-	48.2
	120 - 164	3.4	2.2	-	5.7
	165+	-	-	-	-
	Total	364.1	359.5	-	723.7
II	20 - 49	-	73.4	-	73.4
	50 - 84	-	62.9	-	62.9
	85 - 119	-	8.8	-	8.8
	120 - 164	-	0.5	-	0.5
	165+	-	-	-	-
	Total	-	145.6	-	145.6
III	20 - 49	-	12.4	-	12.4
	50 - 84	-	13.0	-	13.0
	85 - 119	-	1.6	-	1.6
	120 - 164	-	0.2	-	0.2
	165+	-	-	-	-
	Total	-	27.2	-	27.2
IV	20 - 49	-	61.3	51.1	112.4
	50 - 84	-	59.5	48.3	107.8
	85 - 119	-	10.0	5.1	15.1
	120 - 164	-	0.7	0.7	1.4
	165+	-	-	-	-
	Total	-	131.5	105.2	236.7
V	20 - 49	-	24.0	-	24.0
	50 - 84	-	20.4	-	20.4
	85 - 119	-	1.9	-	1.9
	120 - 164	-	0.6	-	0.6
	165+	-	-	-	-
	Total	-	46.9	-	46.9
Total all classes		364.1	710.7	105.2	1,180.0

INVENTORY DATA BY COUNTY

Area by Owner

Both the largest county in the state -- Beaverhead -- and the smallest county -- Silver Bow -- are in Working Circle 3. Some of the ownership patterns are similar between some of the counties, while others show great variation. The percentage of sampled commercial timberland owned by forest industries ranges from one percent in Beaverhead, Jefferson, and Silver Bow Counties to 36 percent in Madison County. State and other public owners ranged from five percent in Broadwater County to 37 percent in Beaverhead County. For other private owners it varied from 55 percent in Madison County to 92 percent in Jefferson County. In each county, the other private ownership group had more sampled commercial timberland than the other two ownership groups combined.

As would be expected, the ownership patterns in Working Circle 3 varied quite a bit between some of the counties (see Table 35). Beaverhead County, the largest in the state, had the most land in five of the eight ownership classes. Although Powell County was average sized for the working circle, it had the most forest industry and National Park Service land. (Beaverhead and Powell Counties had all of the NPS land in the working circle.) Lewis and Clark County had the most county and municipal land.

There were also some differences between counties in the percentages of land owned by the different owners. Forest Service ownership ranged from almost half of Lewis and Clark County to less than a fourth of Broadwater County. A difference of greater magnitude was indicated for BLM land. Only 1.2 percent of Deer Lodge County was administered by the Bureau, as compared to 18.7 percent of Beaverhead County. The greatest difference, though, was in forest industry land. Beaverhead and Silver Bow Counties each had only 0.1 percent while Powell County had a percentage of 6.2 percent. About two-thirds of Beaverhead and Granite Counties was publicly owned, but only about one-third of Broadwater County was. A little more than half of each of the other counties was owned by a public agency.

Table 35. Total land area by owner and county, Working Circle 3 (acres).

Owner	County										Total
	Beaverhead	Broadwater	Deer Lodge	Granite	Jefferson	Lewis and Clark	Madison	Powell	Silver Bow	Total	
Public:						percentage of total					
USDA Forest Service	1,370,443 38.7	184,970 24.3	178,587 37.7	661,481 59.8	462,122 43.6	986,887 44.6	795,104 34.6	638,484 42.8	192,917 42.0	5,470,995 40.8	
USDI Bureau of Land Management	661,700 18.7	66,883 8.8	5,846 1.2	47,283 4.3	96,147 9.1	63,317 2.9	257,291 11.2	78,168 5.2	45,186 9.8	1,321,821 9.9	
USDI National Park Service	656 *	-	-	-	-	-	-	1,528 0.1	-	2,184 *	
Miscellaneous federal	36,555 1.0	7,604 1.0	-	-	-	5,294 0.2	160 *	-	-	49,613 0.4	
Montana Department of State Lands	334,332 9.4	23,796 3.1	7,648 1.6	18,197 1.6	33,392 3.1	134,559 6.1	124,965 5.4	57,986 3.9	13,234 2.9	748,109 5.6	
Other state	16,679 0.5	1,923 0.3	50,854 10.8	2,259 0.2	9,720 0.9	36,926 1.7	24,050 1.0	41,069 2.8	16,094 3.5	199,574 1.5	
County and municipal	1,005 *	750 0.1	291 0.1	204 *	-	2,436 0.1	369 *	340 *	780 0.2	6,175 *	
Subtotal	2,421,370 68.4	285,926 37.6	243,226 51.3	729,424 65.9	601,381 56.7	1,229,419 55.5	1,201,939 52.3	817,575 54.8	268,211 58.3	7,798,471 58.2	
Private:											
Forest industry	2,979 0.1	6,393 0.8	3,258 0.7	42,257 3.8	5,805 0.5	22,585 1.0	67,218 2.9	92,039 6.2	607 0.1	243,141 1.8	
Other private	1,113,910 31.5	468,334 61.6	227,251 48.0	335,001 30.3	452,987 42.7	963,228 43.5	1,028,296 44.8	581,144 39.0	190,952 41.5	5,361,103 40.0	
Subtotal	1,116,889 31.6	474,727 62.4	230,509 48.7	377,258 34.1	458,792 43.3	985,813 44.5	1,095,514 47.7	673,183 45.2	191,559 41.7	5,604,244 41.8	
Total	3,538,259 100.0	760,653 100.0	473,735 100.0	1,106,682 100.0	1,060,173 100.0	2,215,232 100.0	2,297,453 100.0	1,490,758 100.0	459,770 100.0	13,402,715 100.0	

*Indicates less than 0.05 percent.

Timber Resource

Each ownership group in all of the counties had much more softwood commercial timberland than hardwood. Lewis and Clark County had the most commercial timberland, but Powell County had the most volume. Volumes by softwood and hardwood species were similar to those by forest type. Other private land had most of the growth in each county. Cubic foot growth on state and other public land exceeded that on forest industry land, but forest industry land grew more in terms of board feet. In each county there were silvicultural treatment opportunities available to increase growth and improve the health of the timberland.

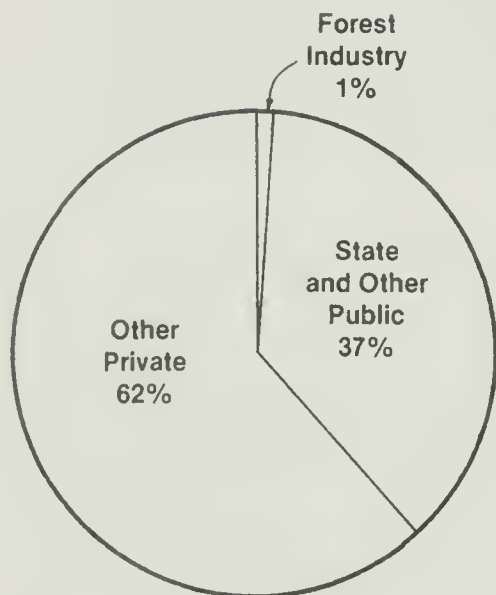
Forest Acreage by Ownership Group

The proportion of sampled commercial timberland by ownership group in each county is given in Figure 13. In Beaverhead, Jefferson, and Silver Bow Counties, forest industries owned only one percent of the sampled commercial timberland as compared to 36 percent in Madison County. The working circle average was just over 12 percent. The percentage of sampled commercial timberland owned by state and other public agencies varied from five percent in Broadwater County to 37 percent in Beaverhead County, with an average of almost 16 percent. Other private owners had 55 percent of the sampled commercial timberland in Madison County, and ranged to 92 percent in Jefferson County. The average was 72 percent.

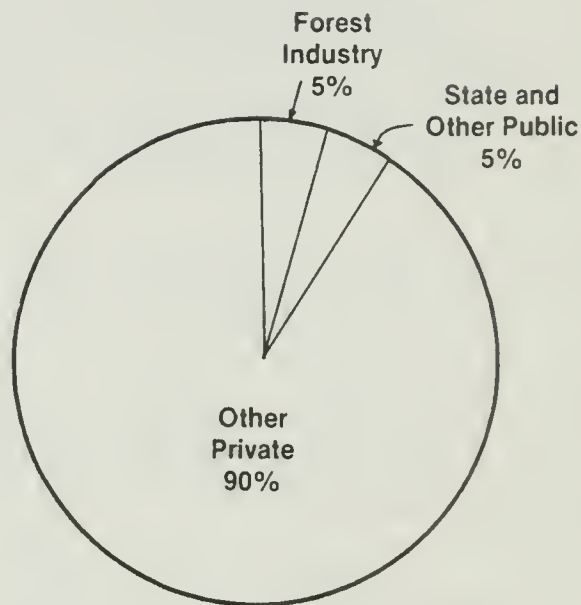
Lewis and Clark County had the most commercial and other (unproductive) timberland sampled in Working Circle 3 (see Table 36 and Table 50 in Appendix 2). The DSL, other public, and other private ownership groups in Lewis and Clark County had more timberland than those groups in the other counties, but Powell County had the most forest industry timberland. In all counties, the other private ownership group had more acreage in each class of timberland than the other three ownership groups combined.

Table 36 gives the area of commercial timberland in softwood and hardwood forest types by ownership group for each county. In all of the counties, and for both hardwood and softwood forest types, the other private ownership group had more sampled commercial timberland than the other two ownership groups combined. Lewis and Clark County had almost one-third of the other private forest land (29 percent) occurring in the working circle. Granite, Madison, and Powell were the only counties where forest industries had substantially more commercial timberland than state and other public own-

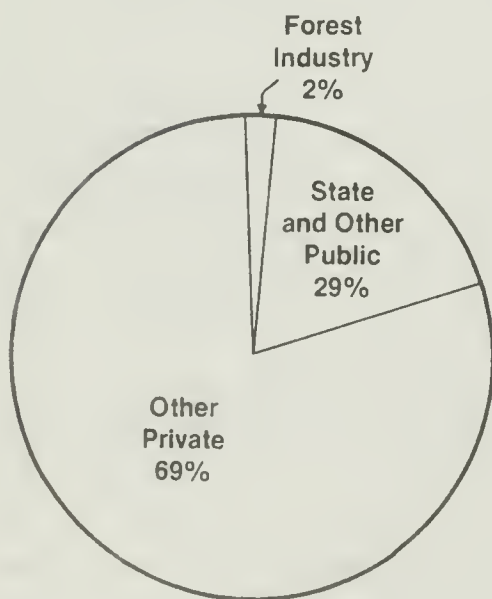
Figure 13. Proportion of sampled commercial timberland by ownership group for each county, Working Circle 3.



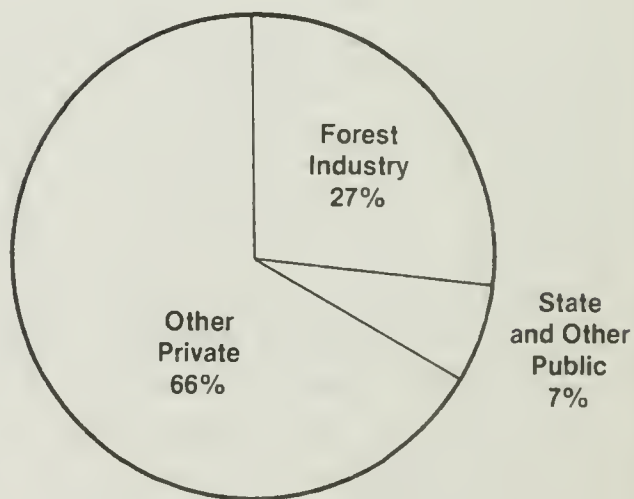
BEAVERHEAD



BROADWATER

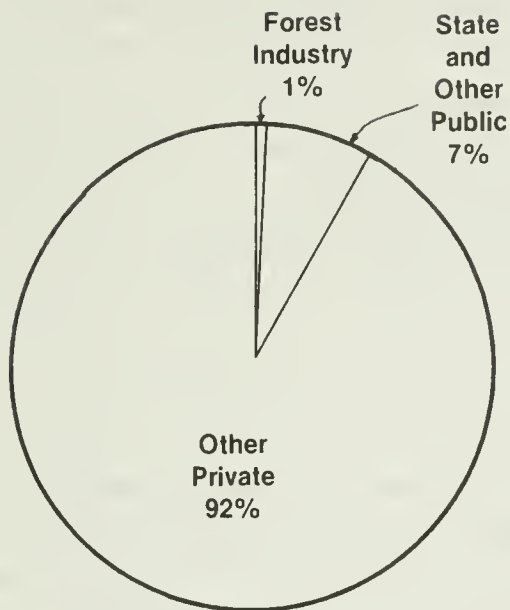


DEER LODGE

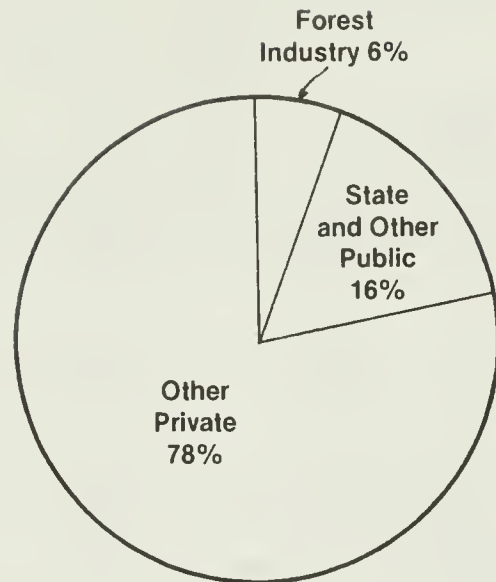


GRANITE

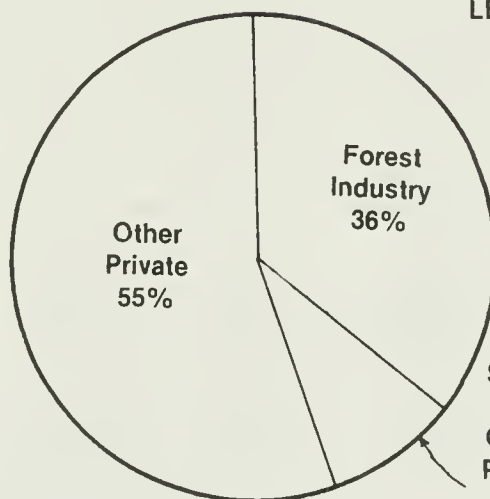
Figure 13.
(page 2)



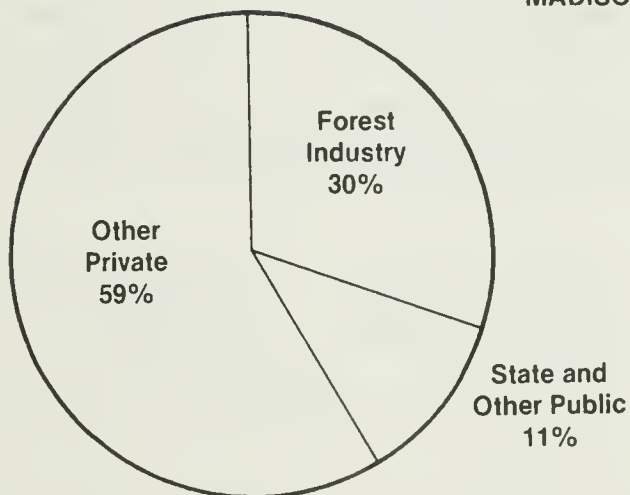
JEFFERSON



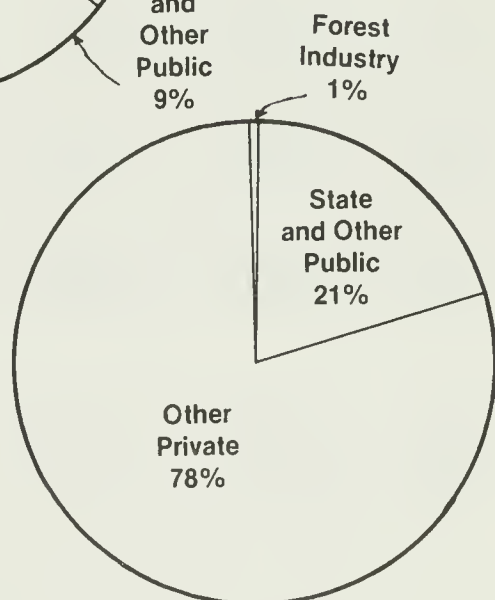
LEWIS AND CLARK



MADISON



POWELL



SILVER BOW

ers. Powell County had 43 percent of the forest industry-owned timberland in the working circle. Every ownership group in all of the counties had much more softwood commercial timberland than hardwood. Beaverhead County had the largest proportion of the sampled commercial timberland on hardwood forest types with 14.0 percent. Deer Lodge County had the smallest proportion on hardwood forest types with 5.0 percent. Lewis and Clark County had the most commercial timberland in the working circle, and Silver Bow County had the least.

Timber Volume by Ownership Group

Although Lewis and Clark County had the most commercial timberland, it was second to Powell County in the amount of volume. Broadwater County had the least volume on the sampled commercial timberland. The other private ownership group had more than half of both the growing stock and sawtimber volume in each county (see Tables 37 and 38). Forest industries had more volume than state and other public owners in Granite, Madison, and Powell Counties. Other private timberlands in Lewis and Clark and Powell Counties had almost equal amounts of board foot volume (23 percent each) which was more than found in any other county. Granite, Madison, and Powell Counties had 87 percent of the board foot volume found on forest industry owned timberland (872,500,000 board feet).

It is not surprising that volumes by softwood and hardwood species were similar to those by forest type. Again, Powell County had the most volume, and Broadwater had the least. Most of the growing stock and sawtimber volume by species was on other private land in every county but Madison, where other private owners had a little less than half of the softwood volume. As before, state and other public owners had more volume than forest industries except in Granite, Madison, and Powell Counties.

Table 36. Area of commercial timberland by county, softwood and hardwood types, and ownership group, Working Circle 3 (thousand acres).

County and Forest Type	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
Beaverhead					
Softwood types	23.7	1.0	35.7	60.4	86.0
Hardwood types	2.2	*	7.7	9.8	14.0
Total all types	25.9	1.0	43.4	70.2	100.0
Broadwater					
Softwood types	2.6	2.7	50.1	55.4	92.2
Hardwood types	0.2	0.2	4.4	4.7	7.8
Total all types	2.8	2.9	54.5	60.1	100.0
Deer Lodge					
Softwood types	20.6	1.4	47.7	69.8	95.0
Hardwood types	0.9	*	2.7	3.6	5.0
Total all types	21.5	1.4	50.5	73.4	100.0
Granite					
Softwood types	9.1	36.8	87.3	133.2	94.5
Hardwood types	0.2	0.9	6.7	7.8	5.5
Total all types	9.3	37.8	94.0	141.1	100.0
Jefferson					
Softwood types	6.2	0.9	77.8	84.9	94.1
Hardwood types	0.4	*	4.8	5.3	5.9
Total all types	6.6	0.9	82.6	90.2	100.0
Lewis and Clark					
Softwood types	48.1	17.7	229.3	295.1	94.6
Hardwood types	2.2	0.5	13.9	16.6	5.4
Total all types	50.3	18.2	243.2	311.7	100.0
Madison					
Softwood types	9.7	43.0	59.1	111.8	91.9
Hardwood types	0.8	0.3	8.7	9.8	8.1
Total all types	10.5	43.3	67.8	121.6	100.0
Powell					
Softwood types	28.0	78.6	145.4	252.1	94.0
Hardwood types	1.4	2.6	12.3	16.2	6.0
Total all types	29.4	81.2	157.7	268.3	100.0
Silver Bow					
Softwood types	8.7	0.2	31.3	40.1	92.6
Hardwood types	0.4	*	2.8	3.3	7.4
Total all types	9.1	0.2	34.1	43.4	100.0
Working Circle Total					
Softwood types	156.8	182.3	763.8	1,102.9	93.5
Hardwood types	8.6	4.6	63.9	77.1	6.5
All forest types	164.5	186.9	827.7	1,180.0	100.0

*Indicates less than 50 acres.

Table 37. Net volume of growing stock on commercial timberland by county, softwood and hardwood species, and ownership group, Working Circle 3 (thousand cubic feet).

County and Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand cubic feet-----				
Beaverhead					
Softwood species	42,107	2,082	65,616	109,805	89.7
Hardwood species	2,981	12	9,600	12,593	10.3
Total all species	45,088	2,094	75,216	122,399	100.0
Broadwater					
Softwood species	2,618	2,442	41,697	46,758	90.4
Hardwood species	287	107	4,616	5,011	9.6
Total all species	2,906	2,550	46,313	51,768	100.0
Deer Lodge					
Softwood species	38,433	2,645	86,964	128,042	97.1
Hardwood species	850	47	2,949	3,847	2.9
Total all species	39,283	2,693	89,913	131,889	100.0
Granite					
Softwood species	18,590	71,276	134,211	224,078	95.6
Hardwood species	337	290	9,674	10,301	4.4
Total all species	18,927	71,566	143,885	234,378	100.0
Jefferson					
Softwood species	6,253	682	84,801	91,736	92.8
Hardwood species	512	62	6,512	7,086	7.2
Total all species	6,765	745	91,312	98,822	100.0
Lewis and Clark					
Softwood species	57,624	34,558	256,530	348,713	94.7
Hardwood species	2,499	65	17,113	19,678	5.3
Total all species	60,124	34,623	273,644	368,390	100.0
Madison					
Softwood species	17,729	83,929	99,794	201,452	94.7
Hardwood species	1,175	348	9,853	11,377	5.3
Total all species	18,904	84,277	109,647	212,828	100.0
Powell					
Softwood species	55,144	147,625	236,013	438,782	95.2
Hardwood species	2,354	436	18,967	21,757	4.8
Total all species	57,497	148,061	254,981	460,539	100.0
Silver Bow					
Softwood species	15,872	207	56,622	72,701	95.7
Hardwood species	464	33	2,755	3,253	4.3
Total all species	16,337	240	59,377	75,954	100.0
Working Circle Total					
Softwood species	254,371	345,447	1,062,248	1,662,066	94.6
Hardwood species	11,460	1,401	82,041	94,902	5.4
Total all species	265,831	346,848	1,144,289	1,756,968	100.0

Table 38. Net volume of sawtimber on commercial timberland by county, softwood and hardwood species, and ownership group, Working Circle 3 (thousand board feet Scribner).

County and Species	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand board feet-----				
Beaverhead					
Softwood species	109,731	5,479	173,844	289,054	87.2
Hardwood species	10,116	43	32,363	42,522	12.8
Total all species	119,848	5,522	206,207	331,576	100.0
Broadwater					
Softwood species	6,870	5,747	102,840	115,457	87.4
Hardwood species	917	273	15,354	16,543	12.6
Total all species	7,786	6,020	118,193	132,000	100.0
Deer Lodge					
Softwood species	94,897	7,502	229,934	332,334	96.9
Hardwood species	2,185	108	8,028	10,321	3.1
Total all species	97,082	7,611	237,962	342,655	100.0
Granite					
Softwood species	53,205	203,624	354,269	611,097	95.7
Hardwood species	714	807	25,825	27,346	4.3
Total all species	53,919	204,430	380,094	638,444	100.0
Jefferson					
Softwood species	16,150	1,795	212,719	230,662	92.2
Hardwood species	1,503	212	17,870	19,586	7.8
Total all species	17,653	2,007	230,589	250,248	100.0
Lewis and Clark					
Softwood species	149,876	106,172	641,893	897,941	94.5
Hardwood species	6,813	153	45,787	52,753	5.5
Total all species	156,689	106,325	687,680	950,694	100.0
Madison					
Softwood species	43,589	229,936	256,615	530,140	93.8
Hardwood species	3,789	936	30,977	35,702	6.2
Total all species	47,379	230,872	287,592	565,842	100.0
Powell					
Softwood species	152,774	436,150	624,365	1,213,291	95.4
Hardwood species	6,252	1,048	50,414	57,714	4.6
Total all species	159,026	437,198	674,779	1,271,005	100.0
Silver Bow					
Softwood species	41,424	409	146,237	188,068	95.5
Hardwood species	1,129	66	7,599	8,793	4.5
Total all species	42,552	475	153,835	196,861	100.0
Working Circle Total					
Softwood species	668,516	996,814	2,742,715	4,408,044	94.2
Hardwood species	33,418	3,646	234,217	271,281	5.8
Total all species	701,934	1,000,460	2,976,932	4,679,326	100.0

Figure 14. Net volume of growing stock by county, Working Circle 3.

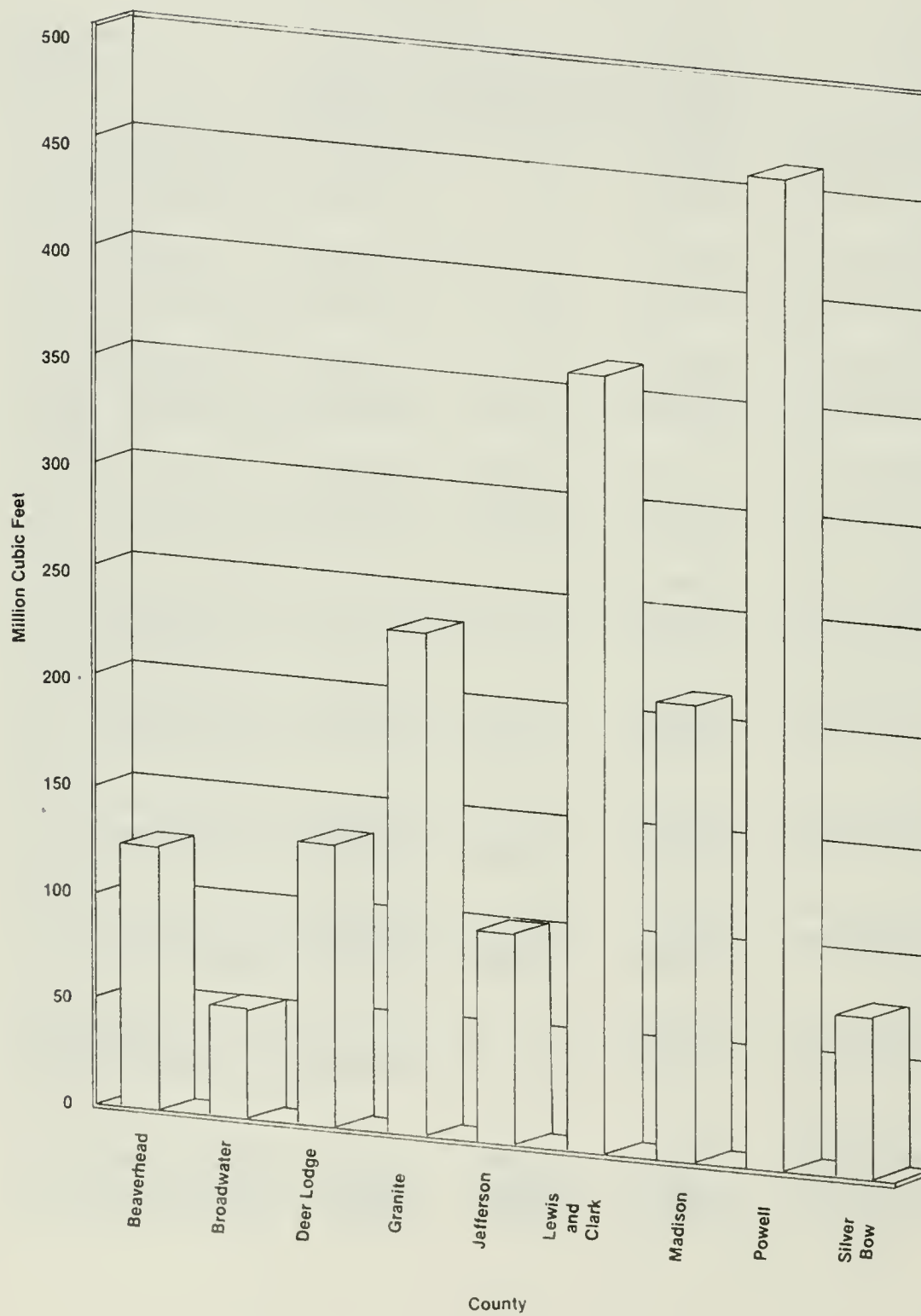
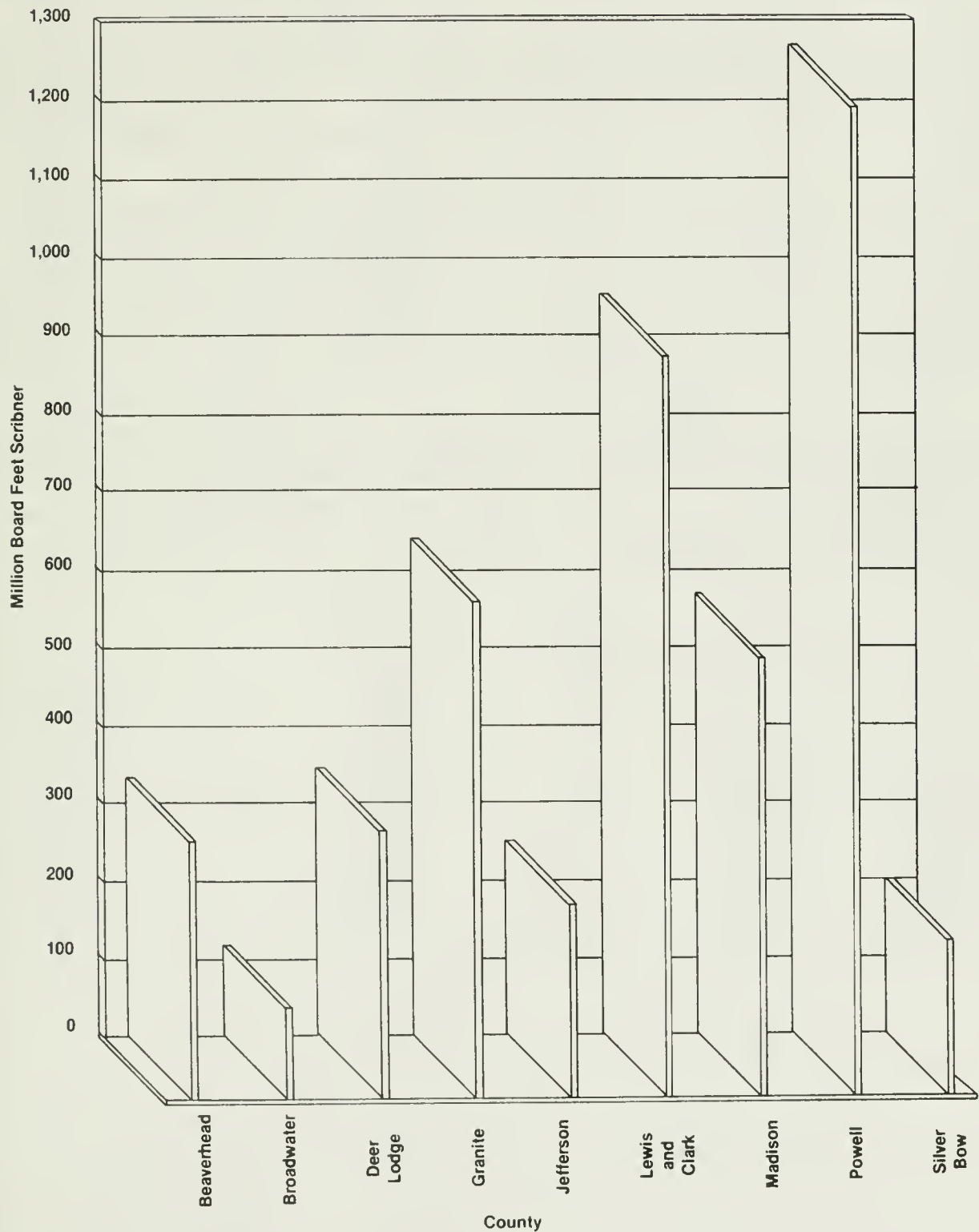


Figure 15. Net volume of sawtimber by county, Working Circle 3.



Growth and Mortality

Broadwater County had the least net annual growth of both growing stock and sawtimber in Working Circle 3 (see Tables 39 and 40). Powell County had the most growth. Other private land provided most of the growth on commercial softwood forest types in each county. Cubic foot growth on state and other public land exceeded that on forest industry land for the working circle, but forest industry land grew more in terms of board feet.

Broadwater County also had the least net annual mortality, and Powell County had the most. Other private owners had the most growing stock mortality in each county except Powell, where forest industries had the most. Thirty-eight percent of the growing stock mortality and 43 percent of the sawtimber mortality was occurring in Powell County (see Tables 41 and 42).

On a per acre basis, Broadwater County had the least growth and mortality of both growing stock and sawtimber (see Tables 55 and 56 in Appendix 2). Silver Bow County had the most cubic foot growth per acre, and the second most board foot growth. Powell County had the most board foot growth per acre, but also the most board foot and cubic foot mortality per acre.

Table 39. Net annual growth of growing stock on commercial softwood forest types by county and ownership group, Working Circle 3 (thousand cubic feet).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand cubic feet-----			
Beaverhead	1,072	51	1,633	2,755
Broadwater	57	49	900	1,006
Deer Lodge	1,027	60	2,143	3,230
Granite	300	963	3,062	4,324
Jefferson	134	21	1,779	1,934
Lewis and Clark	1,095	373	5,361	6,829
Madison	461	1,989	2,510	4,960
Powell	968	1,873	5,301	8,143
Silver Bow	398	6	1,461	1,865
Total	5,511	5,386	24,148	35,045

Table 40. Net annual growth of sawtimber on commercial softwood forest types by county and ownership group, Working Circle 3 (thousand board feet Scribner).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand board feet-----			
Beaverhead	2,380	95	3,543	6,018
Broadwater	184	178	3,124	3,486
Deer Lodge	2,072	139	4,692	6,903
Granite	1,095	4,098	8,204	13,398
Jefferson	446	50	5,846	6,342
Lewis and Clark	3,904	1,787	17,118	22,809
Madison	883	4,321	5,452	10,656
Powell	3,354	8,311	14,476	26,141
Silver Bow	862	13	3,221	4,096
Total	15,180	18,993	65,676	99,849

Table 41. Net annual mortality of growing stock on commercial softwood forest types by county and ownership group, Working Circle 3 (thousand cubic feet).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand cubic feet-----			
Beaverhead	100	6	153	259
Broadwater	5	5	64	73
Deer Lodge	107	5	197	309
Granite	57	426	491	974
Jefferson	11	1	151	163
Lewis and Clark	117	237	527	881
Madison	51	185	240	477
Powell	184	952	882	2,018
Silver Bow	<u>36</u>	<u>*</u>	<u>135</u>	<u>172</u>
Total	669	1,817	2,841	5,327

*Indicates less than 500 cubic feet.

Table 42. Net annual mortality of sawtimber on commercial softwood forest types by county and ownership group, Working Circle 3 (thousand board feet Scribner).

County	Ownership Group			
	State and Other Public	Forest Industry	Other Private	All Owners
	-----thousand board feet-----			
Beaverhead	189	11	316	516
Broadwater	6	4	53	63
Deer Lodge	163	15	414	591
Granite	153	1,271	1,371	2,795
Jefferson	13	1	196	210
Lewis and Clark	225	667	1,078	1,970
Madison	74	432	432	938
Powell	473	2,669	2,433	5,575
Silver Bow	<u>75</u>	<u>1</u>	<u>255</u>	<u>331</u>
Total	1,372	5,071	6,547	12,989

Silvicultural Treatment Opportunities

Often a stand of timber has two or more treatment opportunities available, so the acreage of that stand is applied to each of those opportunities. Commercial timberland acreage by treatment class, shown in Table 43, gives the total number of acres categorized as having a particular treatment opportunity. There are six treatment classes that indicate that no immediate treatment opportunities are available. Those classes are: harvest - low risk; two-storied stand (overstory, harvest - low risk; understory, manageable); no treatment due to productive condition; no treatment - inoperable; no treatment - deferred until merchantable; and unknown - poor crowns, good growth.

The most common treatment class on sampled land in Beaverhead County was harvest - high risk, followed closely by harvest - low risk, and no treatment due to productive condition. If the treatment classes that indicate that immediate treatment opportunities are available are ignored, about 55 percent of the sampled commercial timberland in Beaverhead County had treatment opportunities available.

In Broadwater County, the most common treatment classes were precommercial thinning, regeneration of understocked areas, and overstory removal. About 85 percent of the sampled commercial timberland had treatment opportunities.

Harvest - high risk was the most common treatment class in Deer Lodge County, followed by harvest-low risk and no treatment due to productive condition. There were treatment opportunities available on 57 percent of the sampled commercial timberland.

In Granite County, harvest - high risk and overstory removal were tied for the leading treatment class. Precommercial thinning and harvest - low risk were the next most common. Treatment opportunities were available on 72 percent of the sampled timberland.

The most common treatment classes in Jefferson County were precommercial thinning, regeneration of understocked areas, overstory removal, and sanitation. There were treatment opportunities on 80 percent of the sampled timberland.

Table 43. Area of commercial timberland by treatment class and county, Working Circle 3 (thousand acres).

Treatment Class	County									
	Deer			Lewis and Clark			Powell			Silver
	Beaverhead	Broadwater	Lodge	Granite	Jefferson	Clark	Madison	Powell	Bow	Total
	-----thousand acres-----									
Harvest - high risk	15.4	4.8	18.2	25.4	6.7	31.7	30.1	49.9	10.0	192.1
Harvest - low risk	14.6	3.8	16.6	20.9	7.6	28.1	28.4	41.6	9.2	170.8
Commercial thinning	-	0.7	-	-	0.8	2.0	-	-	-	3.5
Overstory removal	2.4	11.3	3.2	25.4	18.3	59.6	5.1	47.6	2.0	174.8
Two storied stand:	1.5	0.4	1.8	1.6	0.8	3.3	2.6	2.9	1.0	15.8
Overstory, harvest - high risk										
Understory, manageable										
Two storied stand:	-	-	-	-	-	-	-	-	-	-
Overstory, harvest - low risk										
Understory, manageable										
Precommercial thinning	5.7	16.9	7.9	21.4	23.6	78.5	10.9	39.7	4.9	209.5
Stand conversion	1.8	1.5	2.6	11.1	1.7	7.5	3.3	20.7	1.5	51.7
Sanitation	3.9	9.2	3.0	12.2	17.8	50.7	5.3	24.7	1.7	128.7
Regeneration of understocked areas	4.1	15.9	4.7	18.2	19.7	64.4	9.1	29.8	2.5	168.4
No treatment due to productive condition	13.3	4.3	14.7	19.1	9.9	36.1	21.2	36.8	9.1	164.5
No treatment - inoperable	-	0.4	-	-	0.8	2.5	-	-	-	3.6
No treatment - deferred until merchantable	-	1.9	-	1.1	3.3	10.3	-	2.2	-	18.8
Unknown - poor crowns, good growth	-	-	-	3.5	-	1.6	-	7.1	-	12.2

Precommercial thinning was the leading treatment class in Lewis and Clark County, followed by regeneration of understocked areas, overstory removal, and sanitation. Treatment opportunities were available on 79 percent of the sampled commercial timberland.

The most common treatment classes in Madison County were harvest - high risk, harvest - low risk, and no treatment due to productive condition. Treatment opportunities were available on 57 percent of the sampled timberland.

In Powell County, harvest - high risk was the leading treatment class, followed by overstory removal, harvest - low risk, precommercial thinning, and no treatment due to productive condition. There were treatment opportunities available on 71 percent of the sampled commercial timberland.

Harvest - high risk was the most common treatment class in Silver Bow County. Harvest - low risk and no treatment due to productive condition were the next most common classes. Treatment opportunities were available on 56 percent of the sampled commercial timberland.

Grazable Forest Land Data

The timberland in Working Circle 3 can also support livestock. If the condition of the grazable forest land was improved in each county, a substantial increase in the carrying capacity would be obtained.

Although Lewis and Clark County had the most commercial timberland in the excellent and good range condition classes, it also had the most in the fair and poor classes (see Table 44). In fact, on a percentage basis, only Broadwater and Jefferson Counties had more timberland in the fair and poor condition classes. The proportions in the other counties were nearly identical.

In spite of the fact that Lewis and Clark had the most area in each range condition class, Table 45 shows that Powell County had a few more available animal unit months (AUM's). Lewis and Clark and Powell Counties together had about half (49 percent) of the total available animal unit months estimated for the working circle.

Table 44. Area of commercial timberland by county and condition class, Working Circle 3 (thousand acres).

County	Condition Class				Total*
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
Beaverhead	25.3	17.5	6.5	1.7	51.0
Broadwater	14.6	22.8	11.1	1.6	50.1
Deer Lodge	23.9	20.4	6.6	2.7	53.6
Granite	41.9	48.0	16.7	1.3	107.9
Jefferson	22.6	31.3	14.1	2.5	70.5
Lewis and Clark	84.0	108.3	47.6	7.5	247.4
Madison	39.0	35.2	10.3	5.2	89.7
Powell	82.6	85.7	33.4	2.7	204.4
Silver Bow	<u>15.1</u>	<u>11.5</u>	<u>4.0</u>	<u>1.3</u>	<u>31.9</u>
Total	349.1	380.7	150.1	26.6	906.5

*The total does not include timberland with a crown density greater than 70 percent because the understory is considered to have no value for livestock.

Table 46 shows that if all commercial timberland were in excellent range condition, Lewis and Clark County would carry the most AUM's, followed by Powell County. Silver Bow County has the potential to carry the fewest AUM's. In each county, if the range condition was improved, the grazable forest land carrying capacity would increase. The amount of the increase ranged from about a 50 percent increase in Broadwater, Jefferson, and Lewis and Clark Counties to about a 14 percent carrying capacity increase in Beaverhead, Deer Lodge, Madison, and Silver Bow Counties.

Table 45. Available animal unit months (AUM's) on commercial timberland by county and condition class, Working Circle 3.

County	Condition Class				Total
	Excellent	Good	Fair	Poor	
	-----AUM's-----				
Beaverhead	5,848	2,252	296	*	8,396
Broadwater	1,802	2,964	1,347	206	6,319
Deer Lodge	4,743	2,278	293	*	7,314
Granite	6,490	7,886	2,277	130	16,783
Jefferson	2,858	3,887	1,530	330	8,605
Lewis and Clark	10,867	14,104	5,690	965	31,626
Madison	7,836	4,112	413	*	12,361
Powell	12,656	14,113	4,576	287	31,632
Silver Bow	3,313	1,395	204	*	4,912
Total	56,414	52,989	16,626	1,917	127,946

*Indicates less than 0.5 AUM's.

Table 46. Potential animal unit months (AUM's) on commercial timberland by county and crown density, Working Circle 3.

County	Crown Density				Total
	0-30	31-50	51-70	71+*	
	-----AUM's-----				
Beaverhead	2,312	5,692	1,491	-	9,496
Broadwater	5,358	3,000	1,204	-	9,562
Deer Lodge	2,383	4,167	1,767	-	8,317
Granite	11,807	6,821	4,204	-	22,832
Jefferson	6,153	4,072	2,478	-	12,703
Lewis and Clark	23,194	15,097	8,059	-	46,350
Madison	3,685	7,927	2,719	-	14,331
Powell	21,228	13,649	8,299	-	43,177
Silver Bow	1,562	2,929	1,020	-	5,511
Total	77,681	63,355	31,242	-	172,277

*No range data was collected on forest land with greater than 70 percent crown density because the range is considered to have no value for livestock.

CONCLUSIONS AND RECOMMENDATIONS

Overview of the Current Grazable Forestland Resource

In 1978, approximately 77 percent (906,500 acres) of the sampled commercial timberland acreage had less than 71 percent crown density and, therefore, was considered grazable. The condition of the understory was estimated to be excellent or good on about 81 percent (729,800 acres) of the grazable commercial timberland. The current available carrying capacity was estimated to be 127,948 AUM's or about 74 percent of the potential available carrying capacity of 172,277 AUM's. It is necessary to re-evaluate the grazing practices on those acres experiencing a downward trend in range condition to keep the amount of acres in poor or fair condition from increasing.

The amount and location of grazable forest acreage changes from year to year as new stands are logged or burned and as crown densities in existing timber stands increase and block out the sun. In 1978, approximately 77 percent (906,500 acres) of the sampled commercial timberland acreage had less than 71 percent crown density and, therefore, was considered grazable. The condition of the forest understory was estimated to be excellent or good on about 81 percent of the grazable commercial timberland. Timberlands with crown densities of 0-30 percent showed evidence of the most overgrazing. About 34 percent of these areas were in fair or poor condition.

Overall, a total of 176,700 acres of the commercial timberland's understory were determined to be in fair or poor condition. If the ecological condition of the understory on these acres are not currently improving, their stocking rates probably need to be re-evaluated. Some of the grazable timberland that was rated as being in excellent or good condition could also be experiencing overgrazing. Over a period of time even land in excellent condition, if overgrazed, could deteriorate to a poor condition.

The current carrying capacity, defined by the inventory procedures as available animal unit months (AUM's), was estimated to be 127,947 AUM's. If every acre of grazable timberland were in excellent condition, the potential available carrying capacity would be 172,277 AUM's. The actual available carrying capacity was 74 percent of the potential available carrying capacity.

The objective of most grazing management programs is to make optimum use of forage resources while maintaining or improving these resources. It is clear, based on the data, that many acres have not been managed in a manner that would achieve this objective.

Land managers can improve overgrazed areas by simply reducing the amount of time livestock graze an area or by reducing the amount of livestock. Land managers can also maintain or improve the grazing resource and optimize use through more aggressive management techniques that may include some or all of the following items: salting, herding (rotation grazing), fencing, increasing the number of trails, increasing water developments, and reducing slash, logging debris, and other mechanical barriers. Another obvious tactic that may conflict with timber objectives is to maintain lower crown densities or less canopy cover in those forest stands that are being grazed. This could be done by thinning precommercial material or by harvesting some commercial timber while still maintaining a crop of trees for future harvest.

Overview of the Current Timber Resource

The average acre of state and privately owned commercial timberland in Working Circle 3 was estimated to have the potential to produce 54 cubic feet of wood per acre per year. In addition, 40 percent, or 448,100 acres, of the commercial softwood timberland sampled was rated as excellent or good for timber production. These same acres had 2.4 billion board feet of volume or about 55 percent of the total estimated softwood board foot inventory. Sixty-two percent of the softwood net board foot volume was held by the other private ownership group. Forest industries had 23 percent of the softwood volume and state and other public lands had 15 percent.

The data indicates many of the younger sawtimber stands are not even-aged, low in board foot volume, understocked, and have many sapling and pole timber trees of excessive age. It is suggested that when it becomes economical to do so, many of these stands should be harvested and replaced by new, vigorous stands.

The average potential growth for state and private commercial timberland in Working Circle 3 was estimated to be 54 cubic feet per acre per year. Based on unpublished inventory data, this working circle has about average potential timber producing capabilities when compared to potential productivity for the other working circles in the state.

Approximately 40 percent, or 440,100 acres, of the commercial softwood timberland was rated as good or excellent for timber production. These same acres had 2.4 billion board feet of volume or about 55 percent of the total estimated board foot inventory (see Table 64 in Appendix 3).

In 1978, the estimated softwood volume of timber on other privately owned timberlands totaled 2,743 million net board feet Scribner. Forest industry-owned timberlands held an estimated softwood volume of 997 million net board feet. State and other public lands held a softwood volume of 669 million net board feet.

Sixty-three percent of the commercial timberland area had less than 5,000 net board feet per acre, and only 14 percent of the timberland acreage had 10,000 or more board feet per acre (see Table 26).

Only about six percent of the softwood sawtimber volume consisted of the commercially less desirable species -- subalpine fir, limber pine and whitebark pine. Of the remaining more commercially desirable softwood species, 53 percent of the board foot volume was found on trees ranging from 9.0 inches to 15.0 inches d.b.h. (see Table 63 in Appendix 3).

Old growth sawtimber stands had an average of 7,000 net board feet Scribner per acre. Young growth sawtimber stands averaged 4,200 net board feet Scribner per acre. The average number of trees per acre by diameter class and stand size class (see Table 59 in Appendix 3) indicates most of the old growth sawtimber stands, and to a lesser degree the young growth sawtimber stands, are uneven-aged. If the distribution by diameter class for young growth sawtimber stands is analyzed along with the understocked nature of these stands and the excessive age of many of the smaller diameter trees, an unfavorable silvicultural picture begins to unfold. To optimize timber production, many of these stands need to be harvested and started over when it becomes economical to do so.

Past Harvest Rates and Growth

Data covering a 15 year period shows timber harvesting has fluctuated but generally increased on private lands from 1970 to 1980. The average amount of timber harvested annually on private land in Working Circle 3 over 15 years was 88.4 million board feet. Powell County supplied 41 percent of the total volume harvested from private lands during the period. The annual average harvest from private land over the last 15 years is only slightly higher than the board foot net growth estimated for 1978.

Each year, the Forestry Division attempts to determine the amount of timber harvested on state and private lands. This amount is determined from state land records and hazard reduction agreements drawn between the state and logging operators. The board foot volume listed in Table 47 shows the amount of timber loaded on trucks and delivered to mills. Normally, the smallest trees delivered are in the 6-inch diameter class. In addition to the volume brought to the mills, a portion of the merchantable volume is left in the forest as logging residue. Based on figures reported by the USDA Forest Service for western Montana and northern Idaho (Wilson et al. 1970), the amount of residue left on the logging site is about 7 percent of the board foot volume delivered to the mills. Timber is also harvested for railroad ties, posts, poles, rails, and firewood (cord wood) but the amount of timber harvested for these uses is small compared to the amount harvested for other forest products.

Table 47. Volume of sawtimber cut from private lands, calendar years 1968 through 1982, by county, Working Circle 3 (thousand board feet Scribner).

Year	County									
	Beaverhead	Broadwater	Deer	Granite	Jefferson	Lewis and Clark	Madison	Powell	Silver Bow	Total
	-----	-----	-----	-----	-----	thousand board feet-----	-----	-----	-----	-----
1968	10	1,982	197	9,132	441	16,418	945	20,905	-	50,030
1969	-	4,643	194	19,095	895	19,740	497	26,766	566	72,396
1970	-	2,656	13,505	16,259	2,700	18,703	1,650	30,800	-	86,273
1971	31	4,529	8,163	10,527	2,434	8,575	-	26,408	-	60,667
1972	-	3,043	1,493	18,885	3,734	7,522	-	37,816	-	72,493
1973	865	4,165	474	23,377	3,668	14,846	-	51,639	-	99,034
1974	9,059	10,377	511	14,531	4,466	7,159	2,814	38,482	-	87,399
1975	4,160	4,749	546	9,321	3,607	11,575	4,302	46,041	17	84,318
1976	5,452	6,020	7,387	21,066	11,769	13,308	7,339	32,205	297	104,843
1977	9,045	3,223	31	27,020	7,390	24,340	4,645	34,018	98	109,810
1978	11,725	3,726	1,620	22,935	10,845	46,656	1,431	42,726	2,246	143,910
1979	3,988	3,350	201	11,340	4,259	16,907	7,303	54,451	1,525	103,324
1980	1,492	3,130	441	18,508	2,475	25,028	7,883	43,774	15	102,746
1981	128	3,810	6	13,164	6,097	16,121	4,724	30,516	259	74,825
1982	1,310	1,395	2,110	18,043	1,455	9,097	10,900	29,891	166	74,367
Total	47,265	60,798	36,879	253,203	66,235	255,995	54,433	546,438	5,189	1,326,435
15-Year Average	3,151	4,053	2,459	16,880	4,416	17,066	3,629	36,429	346	88,429

Data covering a 15-year cutting period (see Table 47 and Figure 16) shows that timber harvesting has fluctuated wildly but generally increased on private lands from 1970 until 1980. The recently depressed housing market, caused principally by high interest rates, has decreased harvesting rates. The average amount of timber harvested on private land in Working Circle 3 over the 15 years was 88.4 million board feet. Powell County supplied 41 percent of the total volume of timber harvested from private lands during the period.

In 1978, the amount of timber removed from the private land inventory totaled 154.0 million board feet (this figure includes logging residues). The average volume of timber removed from the private land inventory since 1968 has been 94.6 million board feet Scribner annually. (This figure also includes logging residues.) The net annual board foot growth for sawtimber on private lands was estimated to be 91.3 million board feet Scribner in 1978. Subtracting net growth from harvested volume shows the standing inventory of timber was reduced by 62.7 million board feet. In other words, harvesting in 1978 occurred at a rate that was 167 percent of sawtimber board foot growth.

The net board foot growth estimate does not include the board foot growth produced by softwood trees smaller than 9.0 inches d.b.h. or hardwood trees smaller than 11.0 inches d.b.h. Net growth in softwood trees 5.0 to 8.99 inches d.b.h. totaled 23.3 million cubic feet in 1978. Of this net growth, 19.4 million cubic feet occurred in trees in the 6-inch diameter class.

Some or all of the growth produced by poletimber size trees could be considered nullified for comparison purposes since not all of the timber or its growth is available for harvest. According to the timber availability analysis (see Tables 33 and 34), 16 percent of the timber inventoried is not available for harvest due to nontimber resource uses and constraints.

The level of harvesting on private lands in 1978 was the highest recorded since 1968. The 15 year average annual harvest is only slightly higher than the net growth estimated for 1978. However, the period of 1976 through 1980 had an average annual harvest of 112.9 million board feet (not including residues).

Figure 16. Volume cut from private lands, calendar years 1968 through 1982, Working Circle 3 (million board feet Scribner).



Can Production Be Increased

A large amount of the privately owned commercial forest is still at a formative stage and can be manipulated to greatly increase future timber production. Production could also be increased through improved utilization of timber harvested.

Timber production will be a major and probably a primary use of the land for 25 percent of the commercial timberlands in Working Circle 3. The outlook for timber production on the remaining two-thirds owned by non-industrial private landowners is unclear. Getting the non-industrial private forest owner to use intensive timber management practices is difficult. It remains to be seen how well that challenge will be met.

Silvicultural treatment opportunities exist that could dramatically increase the growth rates and thereby increase future timber supplies from state and private timberlands. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.

The future supply of timber from private lands will depend, to a large extent, on the intensity of forest management applied now and in the future. A large amount of the privately owned commercial forest is still in a formative stage and can be manipulated to greatly increase future timber production. An estimated 68 percent of the commercial timberland (748,100 acres) offered silvicultural treatment opportunities which have the potential to increase timber yields from these acres. Table 79 in Appendix 3 shows there were 105.8 million cull trees (20 percent of all live trees greater than or equal to 1.0 inches d.b.h.) existing on commercial timberland. Cull trees do not provide useable growth or volume to the standing inventory. They do, however, occupy space that could be used by growing stock trees. Table 66 in Appendix 3 displays average breast height age by diameter class for various site classes and species groups. Both the average age and the range of ages indicate there are many non-vigorous growing stock trees. These same tables also raise a concern for the genetic quality of the existing trees to produce fast growing seedlings for future crops of timber.

The large amount of silvicultural treatment opportunities, the existence of non-vigorous trees of excessive age scattered throughout the forest, and the large numbers of cull trees are some of the factors which contributed to the modest average net growth of 32 cubic feet per acre per year.

For this working circle, a management plan to improve growth and yield should be three-pronged: It would include conversion of high risk sawtimber stands and many of the uneven aged, understocked, young growth sawtimber stands to younger, fully stocked, mixed species stands; intermediate treatments of submerchantable stands before the opportunity is lost; and a commitment to increase stocking in understocked areas. (Opportunities to increase stocking in understocked areas were most common for timberlands in the 20-49 site class category.)

Production could be further increased through improved utilization of the timber harvested. Employing the latest harvesting and milling technologies would increase the board-foot volume recoverable per tree. These technologies include more efficient log manufacturing, smaller saw kerfs, and a more efficient first cut by the sawyer. Some mills can currently saw smaller diameter logs which increases production because smaller trees can be economically harvested and more of each tree can be used.

A major factor that will affect future yields of timber from private forest lands will be the amount of the commercial timberland contained in relatively small land holdings. In most cases, as forest lands are subdivided and decrease in size, the owners become less willing to sell their timber. Thus, as more of the forest land is developed and subdivided into smaller parcels, more and more of the timber becomes physically and economically unavailable for harvesting.

When this inventory was conducted, only five percent of the sampled commercial timberlands were placed in the other private-individual ownership class. By definition, this ownership class is made up of private land owners with holdings of 40 acres or less. The majority of the timberland sampled (62 percent) was placed in the farmer/rancher owner class. Information and education programs could make these landowners more aware of forest management opportunities. Unfortunately, many individuals need to be contacted before much forest acreage can be treated.

Timber production will be a major and probably a primary use of the land for those timber lands owned by the forest industries and the Montana Department of State Lands (about 25 percent of the total). The outlook for timber production on the two-thirds of the commercial timberland owned by

the non-industrial private landowners is unclear. There will be conflicts between timber production and grazing for livestock or other nontimber resource values. Getting the non-industrial private forest landowner to use aggressive timber management practices is difficult. It remains to be seen how well that challenge will be met.

Silvicultural treatment opportunities exist to dramatically increase the growth rates and thereby increase future timber supplies from the state and private timberlands. The extent to which these opportunities are realized, beginning immediately, will determine the amount of timber available for harvest in the future.

APPENDIX 1. DATA RELIABILITY

The sampling errors presented in tables 48 and 49 are calculated for one standard error -- the 67 percent confidence level. In other words, in two-out-of-three times, the actual value will be within the specified confidence interval. Individual cells within tables should be used with caution. Some of the data presented in other tables are based on small sample sizes and as a result have high sampling errors. For example, the percent error for individual forest type acreages within the commercial timberland total will all have a higher error than 1.8 percent (see table 48).

Table 48. Forest land area and associated sampling error percentages for Working Circle 3.

Item	Softwood Types		Hardwood Types		All Types	
	Acres	Error	Acres	Error	Acres	Error
Commercial timberland	1,102,860	±1.9%	77,140	±19.7%	1,180,000	±1.8%
Other timberland	51,205	±20.6%	14,119	±41.3%	65,324	±18.2%

Table 49. Net volume, net annual growth, and annual mortality on commercial timberland, with associated sampling error percentages for Working Circle 3.

Item	Softwood Species		Hardwood Species		All Species	
	Volume	Error	Volume	Error	Volume	Error
Volume:						
Growing stock (thousand cubic feet)	1,662,066	±4.1%	94,902	±31.7%	1,756,968	±4.1%
Sawtimber (MBF Scribner)	4,408,044	±4.9%	271,281	±39.1%	4,679,326	±5.0%
Net Growth:						
Growing stock (thousand cubic feet)	35,108	±8.7%	2,016	±28.0%	37,124	±8.3%
Sawtimber (MBF Scribner)	99,380	±7.6%	7,838	±29.8%	107,218	±7.3%
Mortality:						
Growing stock (thousand cubic feet)	5,297	±15.6%	218	±58.2%	5,515	±15.2%
Sawtimber (MBF Scribner)	12,989	±21.1%	572	±89.8%	13,562	±20.6%

APPENDIX 2. ADDITIONAL DATA BY COUNTY

Table 50. Area of commercial and other timberland by county and owner, Working Circle 3 (thousand acres).

County and Owner	Commercial Timberland	Other Timberland	Total Timberland
	-----thousand acres-----		
Beaverhead County			
Department of State Lands	23.0	1.1	24.1
Other public*	2.8	0.1	2.9
Forest industry	1.0	**	1.0
Other private	43.4	1.8	45.2
Total	<u>70.2</u>	<u>3.0</u>	<u>73.2</u>
Broadwater County			
Department of State Lands	2.6	0.4	3.0
Other public	0.1	-	0.1
Forest industry	2.9	0.2	3.1
Other private	54.5	7.5	62.0
Total	<u>60.1</u>	<u>8.0</u>	<u>68.1</u>
Deer Lodge County			
Department of State Lands	0.3	**	0.3
Other public	21.2	0.7	21.9
Forest industry	1.4	0.1	1.5
Other private	50.5	3.9	54.4
Total	<u>73.4</u>	<u>4.7</u>	<u>78.1</u>
Granite County			
Department of State Lands	9.2	**	9.2
Other public	0.1	0.1	0.2
Forest industry	37.8	0.1	37.9
Other private	94.0	1.8	95.8
Total	<u>141.1</u>	<u>2.0</u>	<u>143.1</u>
Jefferson County			
Department of State Lands	5.7	0.6	6.3
Other public	1.0	0.2	1.2
Forest industry	0.9	0.4	1.3
Other private	82.6	8.3	90.9
Total	<u>90.2</u>	<u>9.5</u>	<u>99.7</u>
Lewis and Clark County			
Department of State Lands	41.5	2.4	43.9
Other public	8.8	1.4	10.2
Forest industry	18.2	0.1	18.3
Other private	243.2	14.7	257.9
Total	<u>311.7</u>	<u>18.6</u>	<u>330.3</u>

*Other public lands include: other state, county and municipal, and miscellaneous federal land.

**Indicates less than 50 acres.

Table 50.

(Page 2)

County and Owner	Commercial Timberland	Other Timberland	Total Timberland
	-----thousand acres-----		
Madison County			
Department of State Lands	8.5	0.7	9.2
Other public*	2.0	0.7	2.7
Forest industry	43.3	2.1	45.4
Other private	67.8	10.6	78.4
Total	<u>121.6</u>	<u>14.1</u>	<u>135.7</u>
Powell County			
Department of State Lands	19.6	0.1	19.6
Other Public	9.9	0.1	10.0
Forest industry	81.2	-	81.2
Other private	157.7	2.8	160.5
Total	<u>268.3</u>	<u>3.1</u>	<u>271.4</u>
Silver Bow County			
Department of State Lands	2.8	0.1	2.9
Other public	6.3	0.3	6.6
Forest Industry	0.2	**	0.2
Other private	34.1	1.9	36.0
Total	<u>43.4</u>	<u>2.3</u>	<u>45.7</u>
Working Circle Total			
Department of State Lands	113.2	5.4	118.5
Other public	52.2	3.6	55.8
Forest Industry	186.9	3.0	189.9
Other private	827.8	53.3	881.1
Total	<u>1,180.0</u>	<u>65.3</u>	<u>1,245.3</u>

*Other public lands include: other state, county and municipal, and miscellaneous federal land.

**Indicates less than 50 acres.

Table 51. Area of commercial timberland by county, M.A.I. site class, and softwood and hardwood forest types, Working Circle 3 (thousand acres).

County and Site Class	Forest Types		
	Softwood	Hardwood	All
	Forest Types	Forest Types	Forest Types
	-----thousand acres-----		
Beaverhead			
20 - 49	29.4	7.4	36.8
50 - 84	28.8	2.1	30.8
85 - 119	1.5	0.4	1.8
120 - 164	0.7	-	0.7
165+	-	-	-
Total	<u>60.4</u>	<u>9.8</u>	<u>70.2</u>
Broadwater			
20 - 49	39.6	2.4	41.9
50 - 84	14.7	2.3	17.0
85 - 119	1.2	-	1.2
120 - 164	-	-	-
165+	-	-	-
Total	<u>55.4</u>	<u>4.7</u>	<u>60.1</u>
Deer Lodge			
20 - 49	33.4	1.9	35.3
50 - 84	33.6	1.0	34.6
85 - 119	1.8	0.7	2.5
120 - 164	0.9	-	0.9
165+	-	-	-
Total	<u>69.8</u>	<u>3.6</u>	<u>73.4</u>
Granite			
20 - 49	35.2	2.9	38.1
50 - 84	84.0	1.8	85.8
85 - 119	12.7	3.2	15.9
120 - 164	1.3	-	1.3
165+	-	-	-
Total	<u>133.2</u>	<u>7.8</u>	<u>141.1</u>
Jefferson			
20 - 49	56.0	2.1	58.2
50 - 84	26.5	3.2	29.6
85 - 119	2.4	-	2.4
120 - 164	-	-	-
165+	-	-	-
Total	<u>84.9</u>	<u>5.3</u>	<u>90.2</u>
Lewis and Clark			
20 - 49	174.7	6.4	181.1
50 - 84	104.7	8.8	113.4
85 - 119	14.9	1.4	16.3
120 - 164	0.8	-	0.8
165+	-	-	-
Total	<u>295.1</u>	<u>16.6</u>	<u>311.7</u>

Table 51.

(Page 2)

County and Site Class	Forest Types		
	Softwood Forest Types	Hardwood Forest Types	All Forest Types
	-----thousand acres-----		
Madison			
20 - 49	57.5	7.1	64.6
50 - 84	50.3	1.9	52.2
85 - 119	2.8	0.7	3.5
120 - 164	1.3	-	1.3
165+	-	-	-
Total	<u>111.8</u>	<u>9.8</u>	<u>121.6</u>
Powell			
20 - 49	64.5	7.2	71.7
50 - 84	160.6	2.9	163.4
85 - 119	24.3	6.2	30.5
120 - 164	2.8	-	2.8
165+	-	-	-
Total	<u>252.1</u>	<u>16.2</u>	<u>268.3</u>
Silver Bow			
20 - 49	19.0	2.1	21.0
50 - 84	19.6	0.7	20.3
85 - 119	1.0	0.5	1.5
120 - 164	0.5	-	0.5
165+	-	-	-
Total	<u>40.1</u>	<u>3.3</u>	<u>43.4</u>
Working Circle Totals			
20 - 49	509.2	39.5	548.7
50 - 84	522.8	24.5	547.3
85 - 119	62.5	13.1	75.7
120 - 164	8.3	-	8.3
165+	-	-	-
Total	<u>1,102.9</u>	<u>77.1</u>	<u>1,180.0</u>

Table 52. Net volume of growing stock on commercial timberland by county, softwood and hardwood forest types, and ownership group, Working Circle 3 (thousand cubic feet).

County and Forest Types	Ownership Group			Total	%
	State and Other Public	Forest Industry	Other Private		
Beaverhead	-----thousand cubic feet-----				
Softwood types	42,127	2,083	65,647	109,857	89.8
Hardwood types	2,962	11	9,569	12,542	10.2
Total all types	45,089	2,094	75,216	122,399	100.0
Broadwater					
Softwood types	2,644	2,466	42,041	47,151	91.1
Hardwood types	261	84	4,272	4,618	8.9
Total all types	2,906	2,550	46,313	51,768	100.0
Deer Lodge					
Softwood types	38,464	2,647	87,021	128,132	97.2
Hardwood types	819	46	2,892	3,757	2.8
Total all types	39,283	2,693	89,913	131,889	100.0
Granite					
Softwood types	18,659	71,157	133,237	223,053	95.2
Hardwood types	268	409	10,648	11,325	4.8
Total all types	18,927	71,566	143,885	234,378	100.0
Jefferson					
Softwood types	6,300	703	85,263	92,266	93.4
Hardwood types	464	42	6,049	6,555	6.6
Total all types	6,765	745	91,312	98,822	100.0
Lewis and Clark					
Softwood types	57,861	34,427	256,579	348,866	94.7
Hardwood types	2,263	196	17,065	19,524	5.3
Total all types	60,124	34,623	273,644	368,390	100.0
Madison					
Softwood types	17,741	83,949	99,854	201,544	94.7
Hardwood types	1,163	328	9,794	11,285	5.3
Total all types	18,904	84,277	109,647	212,828	100.0
Powell					
Softwood types	55,338	146,966	234,762	437,067	94.9
Hardwood types	2,159	1,095	20,218	23,472	5.1
Total all types	57,497	148,061	254,981	460,539	100.0
Silver Bow					
Softwood types	15,886	208	56,660	72,754	95.8
Hardwood types	450	32	2,717	3,200	4.2
Total all types	16,337	240	59,377	75,954	100.0
Working Circle Total					
Softwood types	255,020	344,605	1,061,065	1,660,690	94.6
Hardwood types	10,811	2,243	83,225	96,278	5.4
Total all types	265,831	346,848	1,144,290	1,756,968	100.0

Table 53. Net volume of sawtimber on commercial timberland by county, softwood and hardwood forest types and ownership group, Working Circle 3 (thousand board feet Scribner).

County and Forest Types	Ownership Group			Total	%
	State and Other Public	Forest Industry	Other Private		
Beaverhead	-----thousand board feet-----				
Softwood types	109,586	5,479	173,591	288,655	87.0
Hardwood types	10,262	43	32,616	42,921	13.0
Total all types	119,848	5,522	206,207	331,576	100.0
Broadwater					
Softwood types	6,960	5,814	103,775	116,549	88.3
Hardwood types	827	206	14,419	15,451	11.7
Total all types	7,786	6,020	118,193	132,000	100.0
Deer Lodge					
Softwood types	94,712	7,485	229,398	331,595	96.8
Hardwood types	2,370	125	8,565	11,060	3.2
Total all types	97,082	7,611	237,962	342,654	100.0
Granite					
Softwood types	53,468	203,021	348,294	604,782	94.7
Hardwood types	451	1,410	31,801	33,661	5.3
Total all types	53,919	204,430	380,094	638,443	100.0
Jefferson					
Softwood types	16,296	1,875	213,923	232,093	92.7
Hardwood types	1,357	132	16,666	18,155	7.3
Total all types	17,653	2,007	230,589	250,248	100.0
Lewis and Clark					
Softwood types	150,512	105,616	640,004	896,132	94.3
Hardwood types	6,177	710	47,676	54,563	5.7
Total all types	156,689	106,325	687,680	950,695	100.0
Madison					
Softwood types	43,494	229,860	256,042	529,396	93.6
Hardwood types	3,884	1,012	31,550	36,446	6.4
Total all types	47,379	230,872	287,592	565,842	100.0
Powell					
Softwood types	153,043	433,269	615,113	1,201,425	94.5
Hardwood types	5,983	3,929	59,667	69,579	5.5
Total all types	159,026	437,198	674,779	1,271,004	100.0
Silver Bow					
Softwood types	41,277	395	145,884	187,556	95.3
Hardwood types	1,275	80	7,951	9,306	4.7
Total all types	42,552	475	153,835	196,862	100.0
Working Circle Total					
Softwood types	669,348	992,813	2,726,023	4,388,183	93.8
Hardwood types	32,586	7,647	250,909	291,142	6.2
Total all types	701,934	1,000,460	2,976,932	4,679,325	100.0

Table 54. Area of commercial softwood timberland by timberland quality class and county, Working Circle 3 (thousand acres).

	County									
Timberland	Beaverhead		Broadwater		Deer Lodge		Granite		Jefferson	
Quality Class	-----thousand acres-----									
	%		%		%		%		%	
Excellent	0.7	1.2	0.8	1.5	0.9	1.3	10.3	7.7	1.6	1.9
Good	15.2	25.1	10.5	18.9	18.2	26.1	70.3	52.8	21.1	24.9
Fair	31.8	52.6	41.9	75.5	36.5	52.4	41.7	31.3	58.9	69.4
Poor	12.7	21.1	2.3	4.1	14.0	20.2	10.9	8.2	3.2	3.8
Total	60.4	100.0	55.4	100.0	69.8	100.0	133.2	100.0	84.9	100.0

Timberland	Lewis & Clark		Madison		Powell		Silver Bow		Total	
Quality Class	-----thousand acres-----									
	%		%		%		%		%	
Excellent	11.2	3.8	1.3	1.1	21.0	8.3	0.5	1.3	48.3	4.4
Good	84.4	28.6	26.9	24.1	134.5	53.4	10.7	26.6	391.8	35.5
Fair	185.5	62.9	58.1	52.0	75.6	30.0	21.2	52.9	551.4	50.0
Poor	14.0	4.7	25.5	22.8	21.0	8.3	7.7	19.2	111.4	10.1
Total	295.1	100.0	111.8	100.0	252.1	100.0	40.1	100.0	1,102.9	100.0

Table 55. Net annual growth per acre on commercial softwood timberland by county, Working Circle 3 (cubic feet/acre and board feet Scribner/acre).

County	Growing Stock		Sawtimber	
	Cubic feet/acre		Board feet/acre	
Beaverhead	46		100	
Broadwater	18		63	
Deer Lodge	46		99	
Granite	32		100	
Jefferson	23		75	
Lewis and Clark	23		77	
Madison	44		95	
Powell	32		104	
Silver Bow	46		102	

Table 56. Net annual mortality per acre on commercial softwood timberland by county, Working Circle 3 (cubic feet/acre and board feet Scribner/acre).

County	Growing Stock		Sawtimber	
	Cubic feet/acre		Board feet/acre	
Beaverhead	4		8	
Broadwater	1		1	
Deer Lodge	4		8	
Granite	7		21	
Jefferson	2		2	
Lewis and Clark	3		6	
Madison	4		8	
Powell	8		22	
Silver Bow	4		8	

APPENDIX 3. ADDITIONAL SURVEY INFORMATION

Table 57. Area of commercial timberland by ownership group, forest type, stand size class, and MAI site class, Working Circle 3 (acres).

State and Other Public

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
Douglas-fir	-----acres-----					
Sawtimber	-	-	3,724	30,424	21,759	55,907
Poletimber	-	1,040	-	5,368	11,941	18,349
Seedlings and saplings	-	-	-	4,316	7,585	11,901
Nonstocked	-	-	-	-	667	667
Total	-	1,040	3,724	40,107	41,953	86,824
Lodgepole pine						
Sawtimber	-	-	1,132	8,789	4,629	14,551
Poletimber	-	911	564	9,231	3,518	14,224
Seedlings and saplings	-	433	37	2,776	1,309	4,555
Nonstocked	-	-	-	498	-	497
Total	-	1,345	1,733	21,295	9,456	33,828
Ponderosa pine						
Sawtimber	-	-	1,300	4,753	8,007	14,059
Poletimber	-	-	-	-	2,410	2,410
Seedlings and saplings	-	-	-	216	1,775	1,991
Nonstocked	-	-	124	-	414	538
Total	-	-	1,424	4,969	12,606	18,998
Subalpine fir-spruce						
Sawtimber	-	-	590	3,953	-	4,543
Poletimber	-	-	-	1,630	400	2,030
Seedlings and saplings	-	-	-	94	1,051	1,146
Nonstocked	-	-	94	-	-	94
Total	-	-	684	5,678	1,452	7,814
Whitebark-limber pine						
Sawtimber	-	-	-	500	3,486	3,986
Poletimber	-	-	-	-	714	714
Seedlings and saplings	-	-	414	-	1,144	1,558
Nonstocked	-	-	-	-	-	-
Total	-	-	414	500	5,344	6,257
Juniper						
Sawtimber	-	-	221	370	1,054	1,645
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	814	814
Total	-	-	221	370	1,868	2,459

Table 57. State and Other Public (continued)

page 2

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Spruce	-	-	-	-	-	-
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	590	590
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	590	590
Western larch	-	-	-	-	-	-
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	-	-
Total softwoods	-	-	-	-	-	-
Sawtimber	-	-	6,967	48,789	38,935	94,691
Poletimber	-	1,951	564	16,229	18,983	37,727
Seedlings and saplings	-	433	451	7,402	13,454	21,741
Nonstocked	-	-	218	498	1,895	2,610
Total	-	2,384	8,200	72,918	73,267	156,769
Aspen	-	-	-	-	-	-
Sawtimber	-	-	320	567	-	887
Poletimber	-	-	646	519	991	2,157
Seedlings and saplings	-	-	-	-	254	254
Nonstocked	-	-	-	591	472	1,064
Total	-	-	966	1,677	1,718	4,361
Cottonwood	-	-	-	-	-	-
Sawtimber	-	-	-	1,725	2,158	3,883
Poletimber	-	-	-	-	311	311
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	59	59
Total	-	-	-	1,725	2,528	4,253
Total hardwoods	-	-	-	-	-	-
Sawtimber	-	-	320	2,292	2,158	4,770
Poletimber	-	-	646	519	1,302	2,468
Seedlings and saplings	-	-	-	-	254	254
Nonstocked	-	-	-	591	531	1,123
Total	-	-	966	3,402	4,245	8,615
All Types	-	-	-	-	-	-
Sawtimber	-	-	7,287	51,081	41,093	99,461
Poletimber	-	1,951	1,210	16,748	20,285	40,195
Seedlings and saplings	-	433	451	7,402	13,708	21,995
Nonstocked	-	-	218	1,089	2,426	3,733
Total	-	2,384	9,166	76,321	77,512	165,384

Table 57. Forest Industry

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas-fir						
Sawtimber	-	3,523	8,700	64,152	12,405	88,780
Poletimber	-	377	-	5,335	6,327	12,039
Seedlings and saplings	-	-	-	8,094	4,112	12,206
Nonstocked	-	-	-	-	88	88
Total	-	3,900	8,700	77,581	22,932	113,112
Lodgepole pine						
Sawtimber	-	-	101	14,859	5,728	20,688
Poletimber	-	-	1,080	12,626	1,909	15,615
Seedlings and saplings	-	-	-	1,652	981	2,633
Nonstocked	-	-	-	36	-	36
Total	-	-	1,181	29,173	8,618	38,972
Ponderosa pine						
Sawtimber	-	-	2,633	569	4,118	7,320
Poletimber	-	-	-	-	195	195
Seedlings and saplings	-	-	-	181	183	364
Nonstocked	-	-	181	-	1,090	1,271
Total	-	-	2,814	750	5,586	9,150
Subalpine fir-spruce						
Sawtimber	-	-	876	6,357	-	7,233
Poletimber	-	-	-	1,252	421	1,674
Seedlings and saplings	-	-	-	3,374	642	4,015
Nonstocked	-	-	-	-	-	-
Total	-	-	876	10,983	1,063	12,921
Whitebark-limber pine						
Sawtimber	-	-	-	535	3,076	3,611
Poletimber	-	-	-	-	1,057	1,057
Seedlings and saplings	-	-	10	-	642	651
Nonstocked	-	-	-	-	-	-
Total	-	-	10	535	4,774	5,319
Juniper						
Sawtimber	-	-	101	60	148	309
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	431	431
Total	-	-	101	60	579	740
Spruce						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	876	876
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	876	876

Table 57. Forest Industry (continued)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
Western larch	-----acres-----					
Sawtimber	-	-	-	1,249	-	1,249
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	1,249	-	1,249
Total softwoods						
Sawtimber	-	3,523	12,411	87,781	25,475	129,190
Poletimber	-	377	1,080	19,213	9,909	30,580
Seedlings and saplings	-	-	10	13,301	7,436	20,745
Nonstocked	-	-	181	36	1,609	1,826
Total	-	3,900	13,682	120,331	44,429	182,341
Aspen						
Sawtimber	-	-	-	197	-	197
Poletimber	-	-	107	27	-	134
Seedlings and saplings	-	-	-	-	2,436	2,436
Nonstocked	-	-	-	88	48	136
Total	-	-	107	313	2,484	2,903
Cottonwood						
Sawtimber	-	-	-	1,514	162	1,676
Poletimber	-	-	-	-	-	-
Seedlings saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	1,514	162	1,676
Total hardwoods						
Sawtimber	-	-	-	1,711	162	1,873
Poletimber	-	-	107	27	-	134
Seedlings and saplings	-	-	-	-	2,436	2,436
Nonstocked	-	-	-	88	48	136
Total	-	-	107	1,826	2,646	4,579
All Types						
Sawtimber	-	3,523	12,411	89,492	25,637	131,063
Poletimber	-	377	1,187	19,240	9,909	30,714
Seedlings and saplings	-	-	10	13,301	9,872	23,181
Nonstocked	-	-	181	124	1,657	1,962
Total	-	3,900	13,788	122,157	47,073	186,917

Table 57. Other Private

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
	-----acres-----					
Douglas-fir	-	-	15,955	161,207	117,745	294,907
Sawtimber	-	-	-	-	-	-
Poletimber	-	2,057	-	30,023	53,579	85,659
Seedlings and saplings	-	-	-	21,339	46,663	68,002
Nonstocked	-	-	-	-	6,683	6,683
Total	-	2,057	15,955	212,568	224,669	455,250
Lodgepole pine	-	-	-	-	-	-
Sawtimber	-	-	1,492	23,036	14,615	39,143
Poletimber	-	-	5,924	29,083	20,336	55,342
Seedlings and saplings	-	-	2,386	10,131	10,231	22,747
Nonstocked	-	-	-	2,947	-	2,947
Total	-	-	9,801	65,197	45,182	120,180
Ponderosa pine	-	-	-	-	-	-
Sawtimber	-	-	3,873	20,711	52,444	77,029
Poletimber	-	-	-	-	15,875	15,875
Seedlings and saplings	-	-	-	3,167	11,448	14,614
Nonstocked	-	-	696	-	3,103	3,799
Total	-	-	4,570	23,878	82,869	111,317
Subalpine fir-spruce	-	-	-	-	-	-
Sawtimber	-	-	2,184	16,910	-	19,094
Poletimber	-	-	-	4,241	1,786	6,027
Seedlings and saplings	-	-	-	3,538	3,207	6,745
Nonstocked	-	-	3,538	-	-	3,538
Total	-	-	5,721	24,689	4,993	35,404
Whitebark-limber pine	-	-	-	-	-	-
Sawtimber	-	-	-	1,546	11,074	12,620
Poletimber	-	-	-	-	2,880	2,880
Seedlings and saplings	-	-	3,103	-	5,678	8,780
Nonstocked	-	-	-	-	-	-
Total	-	-	3,103	1,546	19,631	24,280
Juniper	-	-	-	-	-	-
Sawtimber	-	-	1,492	1,653	7,104	10,248
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	4,889	4,889
Total	-	-	1,492	1,653	11,993	15,137
Spruce	-	-	-	-	-	-
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	2,184	2,184
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	2,184	2,184

Table 57. Other Private (continued)

Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
Western larch	-----acres-----					
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	-	-
Total softwoods						
Sawtimber	-	-	24,996	225,063	202,982	453,041
Poletimber	-	2,057	5,924	63,347	94,456	165,783
Seedlings and saplings	-	-	5,489	38,175	79,411	123,072
Nonstocked	-	-	4,234	2,947	14,675	21,856
Total	-	2,057	40,643	329,532	391,524	763,752
Aspen						
Sawtimber	-	-	6,863	3,873	-	10,736
Poletimber	-	-	5,199	4,141	4,688	14,028
Seedlings and saplings	-	-	-	-	6,969	6,969
Nonstocked	-	-	-	2,981	3,256	6,237
Total	-	-	12,062	10,995	14,913	37,970
Cottonwood						
Sawtimber	-	-	-	8,309	13,857	22,166
Poletimber	-	-	-	-	2,955	2,955
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	856	856
Total	-	-	-	8,309	17,669	25,978
Total hardwoods						
Sawtimber	-	-	6,863	12,182	13,857	32,902
Poletimber	-	-	5,199	4,141	7,643	16,983
Seedlings and saplings	-	-	-	-	6,969	6,969
Nonstocked	-	-	-	2,981	4,112	7,093
Total	-	-	12,062	19,304	32,581	63,947
All types						
Sawtimber	-	-	31,859	237,245	216,839	485,943
Poletimber	-	2,057	11,123	67,488	102,099	182,766
Seedlings and saplings	-	-	5,489	38,175	86,380	130,041
Nonstocked	-	-	4,234	5,928	18,787	28,949
Total	-	2,057	52,703	348,834	424,104	827,699

Table 57. Working Circle Total

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Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
Douglas-fir	-----acres-----					
Sawtimber	-	3,523	28,379	255,783	151,908	439,594
Poletimber	-	3,474	-	40,725	71,848	116,047
Seedlings and saplings	-	-	-	33,748	58,361	92,109
Nonstocked	-	-	-	-	7,438	7,438
Total	-	6,997	28,379	330,256	289,554	655,187
Lodgepole pine						
Sawtimber	-	-	2,725	46,685	24,972	74,381
Poletimber	-	911	7,568	50,940	25,763	85,182
Seedlings and saplings	-	433	2,422	14,559	12,521	29,935
Nonstocked	-	-	-	3,481	-	3,481
Total	-	1,345	12,715	115,664	63,256	192,980
Ponderosa pine						
Sawtimber	-	-	7,806	26,033	64,569	98,408
Poletimber	-	-	-	-	18,480	18,480
Seedlings and saplings	-	-	-	3,564	13,405	16,969
Nonstocked	-	-	1,001	-	4,606	5,608
Total	-	-	8,807	29,597	101,061	139,465
Subalpine fir-spruce						
Sawtimber	-	-	3,649	27,221	-	30,870
Poletimber	-	-	-	7,123	2,608	9,731
Seedlings and saplings	-	-	-	7,006	4,900	11,906
Nonstocked	-	-	3,632	-	-	3,632
Total	-	-	7,281	41,350	7,508	56,139
Whitebark-limber pine						
Sawtimber	-	-	-	2,581	17,636	20,217
Poletimber	-	-	-	-	4,651	4,651
Seedlings and saplings	-	-	3,526	-	7,463	10,989
Nonstocked	-	-	-	-	-	-
Total	-	-	3,526	2,581	29,749	35,856
Juniper						
Sawtimber	-	-	1,813	2,083	8,306	12,202
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	6,134	6,134
Total	-	-	1,813	2,083	14,440	18,336
Spruce						
Sawtimber	-	-	-	-	-	-
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	3,649	3,649
Nonstocked	-	-	-	-	-	-
Total	-	-	-	-	3,649	3,649

Table 57. Working Circle Total (continued)

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Forest Type and Stand Size Class	Site Class					All Classes
	165+	120-164	85-119	50-84	20-49	
Western larch	-----acres-----					
Sawtimber	-	-	-	1,249	-	1,249
Poletimber	-	-	-	-	-	-
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	-	-
Total	-	-	-	1,249	-	1,249
Total softwoods						
Sawtimber	-	3,523	44,372	361,635	267,391	676,921
Poletimber	-	4,385	7,568	98,788	123,350	234,091
Seedlings and saplings	-	433	5,948	58,877	100,299	165,557
Nonstocked	-	-	4,633	3,481	18,178	26,293
Total	-	8,341	62,521	522,781	509,218	1,102,862
Aspen						
Sawtimber	-	-	7,183	4,638	-	11,820
Poletimber	-	-	5,952	4,687	5,679	16,318
Seedlings and saplings	-	-	-	-	9,660	9,660
Nonstocked	-	-	-	3,660	3,776	7,436
Total	-	-	13,134	12,985	19,115	45,234
Cottonwood						
Sawtimber	-	-	-	11,547	16,177	27,724
Poletimber	-	-	-	-	3,266	3,266
Seedlings and saplings	-	-	-	-	-	-
Nonstocked	-	-	-	-	916	916
Total	-	-	-	11,547	20,359	31,906
Total hardwoods						
Sawtimber	-	-	7,183	16,185	16,177	39,544
Poletimber	-	-	5,952	4,687	8,945	19,584
Seedlings and saplings	-	-	-	-	9,660	9,660
Nonstocked	-	-	-	3,660	4,692	8,352
Total	-	-	13,134	24,532	39,474	77,140
All Types						
Sawtimber	-	3,523	51,555	377,820	283,568	716,465
Poletimber	-	4,385	13,520	103,475	132,295	253,675
Seedlings and saplings	-	433	5,948	58,877	109,959	175,217
Nonstocked	-	-	4,633	7,141	22,870	34,645
Total	-	8,342	75,657	547,312	548,690	1,180,000

Table 58. Area of commercial timberland by stand volume class and ownership group, Working Circle 3 (thousand acres).

Cubic Foot Volume Class	Ownership Group							
	State and Other Public		Forest Industry		Other Private		Total	
	-----thousand acres-----		-----thousand acres-----		-----thousand acres-----		-----thousand acres-----	
	%		%		%		%	
Less than 500	29.4	17.8	29.8	15.9	199.2	24.1	258.4	21.9
500 - 1,499	64.0	38.7	65.0	34.8	328.6	39.7	457.6	38.8
1,500 - 2,499	39.8	24.1	36.7	19.6	174.9	21.1	251.4	21.3
2,500 - 3,499	14.1	8.5	29.9	16.0	65.7	7.9	109.6	9.3
3,500 - 4,999	16.1	9.7	25.2	13.5	57.3	6.9	98.6	8.3
5000 or more	2.0	1.2	0.4	0.2	2.1	0.3	4.4	0.4
Total all classes	165.4	100.0	186.9	100.0	827.7	100.0	1,180.0	100.0

Table 59. Number of growing stock trees per acre by diameter class and stand size class on commercial timberland, Working Circle 3.

Diameter Class	Stand Size Class					
	Old Growth	Young Growth	Seedlings and		Overall	
	Sawtimber	Sawtimber	Poletimber	Saplings	Nonstocked	Average
	-----average number of trees/acre-----					
1.0 - 2.9	107.73	79.46	233.62	491.05	-	178.07
3.0 - 4.9	78.64	54.10	230.32	137.52	-	108.59
5.0 - 6.9	46.98	48.78	164.90	32.59	-	69.48
7.0 - 8.9	35.65	33.22	86.49	11.28	1.00	41.04
9.0 - 10.9	30.63	27.69	29.03	4.95	1.31	24.52
11.0 - 12.9	19.91	17.93	9.74	3.59	2.26	14.05
13.0 - 14.9	10.53	9.42	2.27	1.68	-	6.72
15.0 - 16.9	7.15	4.81	1.33	1.04	0.58	3.93
17.0 - 18.9	4.01	3.28	0.56	0.32	0.06	2.33
19.0 - 20.9	2.39	1.75	0.34	0.24	0.46	1.34
21.0 - 22.9	1.43	1.13	0.19	0.07	-	0.81
23.0 - 24.9	1.02	0.45	0.08	0.07	0.11	0.44
25.0 - 26.9	0.41	0.31	0.09	0.02	-	0.23
27.0 - 28.9	0.30	0.21	0.01	0.02	0.11	0.16
29.0+	0.38	0.28	0.04	0.05	0.02	0.21
Total	347.16	282.82	759.01	684.49	5.91	451.92

Table 60. Net volume of growing stock on commercial timberland by forest type and species, Working Circle 3 (thousand cubic feet).

Softwood Species

Forest Type	Whitebark-						Western larch*
	Douglas- fir	Lodgepole pine	Ponderosa pine	Subalpine fir	limber pine	Spruce	
	-----thousand cubic feet-----						
Douglas-fir	759,544	97,338	45,459	1,674	5,462	7,933	6,628
Lodgepole pine	37,447	375,003	1,770	12,170	1,263	6,569	1,367
Ponderosa pine	15,013	3,698	103,456	-	189	-	-
Subalpine fir- spruce	5,357	17,805	-	44,482	13,301	31,451	1,249
Whitebark- limber pine	2,728	1,222	-	2,752	33,054	4,289	-
Juniper	3,289	3,633	597	-	98	1,178	-
Spruce	409	-	-	-	-	580	-
Western larch	356	-	152	-	-	-	1,771
Softwood types	824,142	498,700	151,433	61,078	53,367	52,000	11,015
Aspen	1,843	4,247	3,678	-	-	150	-
Cottonwood	338	-	-	-	-	-	-
Hardwood types	2,182	4,247	3,678	-	-	150	75
Total all types	826,323	502,947	155,110	61,078	53,367	52,150	11,090

Hardwood Species

Forest Type	Total Softwood Species	Aspen	Cottonwood	Other Hardwoods	Total Hardwood Species	Total All Species
	-----thousand cubic feet-----					
Douglas-fir	924,038	2,369	1,619	-	3,987	928,026
Lodgepole pine	435,589	2,449	453	-	2,902	438,491
Ponderosa pine	122,355	-	529	-	529	122,884
Subalpine fir- spruce	113,645	393	-	-	393	114,038
Whitebark- limber pine	44,045	-	-	-	-	44,045
Juniper	8,795	579	566	-	1,145	9,939
Spruce	989	-	-	-	-	989
Western larch	2,278	-	-	-	-	2,278
Softwood types	1,651,734	5,790	3,167	-	8,956	1,660,690
Aspen	9,919	39,100	2,541	-	41,641	51,560
Cottonwood	414	715	43,141	449	44,305	44,718
Hardwood types	10,332	39,815	45,682	449	85,946	96,278
Total all types	1,662,066	45,604	48,849	449	94,902	1,756,968

*May also include a small amount of subalpine larch.

Table 61. Net volume of sawtimber on commercial timberland by forest type and species, Working Circle 3 (thousand board feet Scribner).

Softwood Species

Forest Type	Douglas- fir	Lodgepole pine	Ponderosa pine	Whitebark- limber		Spruce	Western larch*
				fir	pine		
				-----thousand board feet-----			
Douglas-fir	2,287,198	206,295	164,222	3,257	14,608	29,567	19,151
Lodgepole pine	99,487	644,029	8,132	23,086	2,920	19,560	5,858
Ponderosa pine	24,666	17,756	304,178	-	504	-	-
Subalpine fir- spruce	19,845	57,812	-	81,677	39,388	126,492	6,380
Whitebark- limber pine	7,886	425	-	6,128	85,672	18,936	-
Juniper	8,736	15,153	2,937	-	454	3,611	-
Spruce	-	-	-	-	-	-	-
Western larch	1,096	-	784	-	-	-	8,580
Softwood types	2,448,914	941,470	480,255	114,147	143,546	198,165	39,970
Aspen	8,632	12,813	18,664	-	-	664	-
Cottonwood	804	-	-	-	-	-	-
Hardwood types	9,436	12,813	18,664	-	-	664	-
Total all types	2,458,350	954,283	498,919	114,147	143,546	198,829	39,970

Hardwood Species

	Total Softwood Species	Aspen	Cottonwood	Other hardwoods	Total Hardwood Species	Total All Species
	-----thousand board feet-----					
Douglas-fir	2,724,298	-	6,673	-	6,673	2,730,970
Lodgepole pine	803,071	7,827	1,883	-	9,710	812,781
Ponderosa pine	347,105	-	1,307	-	1,307	348,412
Subalpine fir- spruce	331,594	1,721	-	-	1,721	333,315
Whitebark- limber pine	119,047	-	-	-	-	119,047
Juniper	30,891	-	2,306	-	2,306	33,197
Spruce	-	-	-	-	-	-
Western larch	10,461	-	-	-	-	10,461
Softwood types	4,366,468	9,547	12,168	-	21,716	4,388,183
Aspen	40,773	74,859	10,514	-	85,373	126,145
Cottonwood	804	1,682	161,780	731	164,193	164,997
Hardwood types	41,577	76,541	172,294	731	249,566	291,142
Total all types	4,408,044	86,088	184,462	731	271,281	4,679,326

*May also include a small amount of subalpine larch.

Table 62. Net volume of growing stock on commercial timberland by diameter class, species, and ownership group, Working Circle 3 (thousand cubic feet).

Diameter Class	Softwood Species						
	Douglas-	Lodgepole	Ponderosa	Western	Subalpine	Whitebark-	
	fir	pine	pine	larch	fir	Spruce	limber pine
	-----thousand cubic feet-----						
5.0 - 6.9	14,087	22,446	1,308	10	3,204	928	1,338
7.0 - 8.9	15,712	23,040	2,164	55	2,509	703	1,886
9.0 - 10.9	15,807	19,302	2,878	13	1,851	1,143	2,654
11.0 - 12.9	16,643	12,584	3,433	78	1,562	657	1,232
13.0 - 14.9	11,094	6,134	3,114	99	631	989	814
15.0 - 16.9	9,790	3,910	2,403	288	463	1,263	767
17.0 - 18.9	8,193	1,455	1,840	276	174	836	316
19.0 - 20.9	5,996	466	1,106	26	229	452	492
21.0 - 22.9	4,697	151	1,000	227	49	598	297
23.0 - 24.9	4,060	7	438	-	54	153	77
25.0 - 26.9	2,727	6	632	-	-	238	97
27.0 - 28.9	1,759	-	318	108	-	150	-
29.0+	2,809	7	676	-	-	124	67
All Classes	113,373	89,508	21,310	1,181	10,727	8,235	10,037

Hardwood Species

Diameter Class	Total				Total	Total
	Softwood	Other			Hardwood	All
	Species	Aspen	Cottonwood	hardwoods	Species	Species
	-----thousand cubic feet-----					
5.0 - 6.9	43,320	598	40	-	639	43,959
7.0 - 8.9	46,070	763	309	64	1,136	47,206
9.0 - 10.9	43,648	1,350	337	-	1,686	45,335
11.0 - 12.9	36,190	898	718	42	1,658	37,848
13.0 - 14.9	22,876	357	867	-	1,224	24,099
15.0 - 16.9	18,885	64	419	-	483	19,368
17.0 - 18.9	13,091	53	913	-	966	14,057
19.0 - 20.9	8,766	78	831	-	908	9,675
21.0 - 22.9	7,019	8	925	-	933	7,952
23.0 - 24.9	4,788	-	502	-	502	5,291
25.0 - 26.9	3,700	4	326	-	330	4,030
27.0 - 28.9	2,334	5	413	-	418	2,752
29.0+	3,683	-	577	-	577	4,259
All Classes	254,371	4,178	7,175	107	11,460	265,831

Table 62.

(Page 2)

Forest Industry

Softwood Species

Diameter Class	Softwood Species						Whitebark- limber
	Douglas- fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Spruce	pine
	-----thousand cubic feet-----						
5.0 - 6.9	14,701	28,855	115	1,235	3,527	573	1,437
7.0 - 8.9	18,639	31,022	681	816	2,951	377	1,800
9.0 - 10.9	27,188	20,139	2,301	1,802	2,384	1,060	2,590
11.0 - 12.9	28,068	11,186	2,335	883	2,349	793	1,186
13.0 - 14.9	23,295	7,186	1,886	863	983	1,072	690
15.0 - 16.9	20,091	3,777	3,280	296	539	1,175	782
17.0 - 18.9	17,076	906	1,805	341	259	717	409
19.0 - 20.9	11,419	363	3,467	945	308	480	507
21.0 - 22.9	5,893	199	1,588	301	73	479	247
23.0 - 24.9	4,236	-	920	697	80	119	99
25.0 - 26.9	2,984	-	418	449	-	250	103
27.0 - 28.9	3,796	-	380	154	-	52	-
29.0+	5,410	-	274	135	-	128	72
All Classes	182,795	103,633	19,450	8,917	13,453	7,276	9,924

Hardwood Species

Diameter Class	Total Softwood Species	Hardwood Species			Total Hardwood Species	Total All Species
		Aspen	Cottonwood	Other hardwoods		
	-----thousand cubic feet-----					
5.0 - 6.9	50,443	118	8	-	126	50,569
7.0 - 8.9	56,287	36	35	12	84	56,371
9.0 - 10.9	57,464	197	122	-	319	57,783
11.0 - 12.9	46,801	37	47	8	92	46,894
13.0 - 14.9	35,974	37	104	-	141	36,115
15.0 - 16.9	29,940	2	30	-	33	29,973
17.0 - 18.9	21,512	21	181	-	202	21,714
19.0 - 20.9	17,490	16	68	-	84	17,574
21.0 - 22.9	8,780	-	170	-	170	8,950
23.0 - 24.9	6,152	-	56	-	56	6,207
25.0 - 26.9	4,204	-	32	-	32	4,236
27.0 - 28.9	4,382	-	23	-	23	4,405
29.0+	6,018	-	41	-	41	6,059
All Classes	345,447	464	917	21	1,401	346,848

Table 62.

(Page 3)

Other Private

Softwood Species

Diameter Class	Douglas- fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Whitebark- limber	
						Spruce	pine
5.0 - 6.9	63,264	87,938	7,580	210	11,114	3,099	5,125
7.0 - 8.9	78,682	84,316	11,831	-	8,348	1,860	6,529
7.0 - 10.9	84,911	57,954	14,838	279	6,472	4,889	8,427
11.0 - 12.9	84,037	37,848	15,386	-	5,632	3,828	3,969
13.0 - 14.9	56,034	20,499	15,324	-	1,694	5,702	2,538
15.0 - 16.9	46,118	11,965	13,416	-	1,809	3,736	2,421
17.0 - 18.9	36,669	5,756	10,387	169	646	3,819	1,097
19.0 - 20.9	21,976	2,100	8,852	178	800	3,831	1,676
21.0 - 22.9	19,053	635	6,696	-	182	1,800	854
23.0 - 24.9	13,925	309	2,584	-	200	657	263
25.0 - 26.9	7,704	172	1,549	-	-	1,224	299
27.0 - 28.9	5,344	-	1,502	157	-	877	-
29.0+	12,439	312	4,406	-	-	1,317	207
All Classes	530,155	309,806	114,350	993	36,898	36,640	33,406

Hardwood Species

Diameter Class	Total Softwood Species	Other hardwoods			Total Hardwood Species	Total All Species
	Aspen	Cottonwood				
-----thousand cubic feet-----						
5.0 - 6.9	178,329	3,451	111	-	3,562	181,891
7.0 - 8.9	191,567	5,890	1,649	193	7,733	199,300
9.0 - 10.9	177,769	13,429	1,646	-	15,075	192,844
11.0 - 12.9	150,701	10,769	4,317	128	15,214	165,915
13.0 - 14.9	101,791	5,011	4,267	-	9,278	111,069
15.0 - 16.9	79,465	849	2,564	-	3,413	82,878
17.0 - 18.9	58,544	565	5,289	-	5,854	64,398
19.0 - 20.9	39,413	751	4,809	-	5,560	44,973
21.0 - 22.9	29,221	118	5,350	-	5,468	34,689
23.0 - 24.9	17,938	-	3,147	-	3,147	21,085
25.0 - 26.9	10,948	59	1,941	-	2,001	12,949
27.0 - 28.9	7,881	71	2,408	-	2,479	10,360
29.0+	18,681	-	3,258	-	3,258	21,939
All Classes	1,062,248	40,963	40,757	321	82,041	1,144,289

Table 62.

(Page 4)

Working Circle Total

Diameter Class	Softwood Species					Whitebark-	
	Douglas-	Lodgepole	Ponderosa	Western	Subalpine	limber	
	fir	pine	pine	larch	fir	Spruce	pine
	-----thousand cubic feet-----						
5.0 - 6.9	92,051	139,239	9,003	1,454	17,845	4,600	7,900
7.0 - 8.9	113,033	138,379	14,677	871	13,807	2,941	10,216
9.0 - 10.9	127,905	97,396	20,016	2,094	10,707	7,092	13,671
11.0 - 12.9	128,748	61,618	21,155	962	9,543	5,278	6,387
13.0 - 14.9	90,422	33,818	20,324	962	3,308	7,763	4,043
15.0 - 16.9	75,999	19,652	19,099	584	2,812	6,174	3,971
17.0 - 18.9	61,937	8,116	14,032	787	1,079	5,372	1,822
19.0 - 20.9	39,391	2,930	13,425	1,149	1,337	4,762	2,676
21.0 - 22.9	29,643	986	9,283	528	305	2,878	1,398
23.0 - 24.9	22,221	316	3,942	697	335	929	439
25.0 - 26.9	13,415	178	2,599	449	-	1,713	499
27.0 - 28.9	10,899	-	2,200	419	-	1,078	-
29.0+	20,657	319	5,356	135	-	1,569	346
All Classes	826,323	502,947	155,110	11,090	61,078	52,150	53,367

Hardwood Species

Diameter Class	Total				Total	Total
	Softwood	Other			Hardwood	All
	species	Aspen	Cottonwood	hardwoods	Species	Species
	-----thousand cubic feet-----					
5.0 - 6.9	272,092	4,167	160	-	4,326	276,419
7.0 - 8.9	293,924	6,690	1,993	270	8,953	302,877
9.0 - 10.9	278,881	14,975	2,105	-	17,080	295,962
11.0 - 12.9	233,691	11,705	5,081	178	16,965	250,656
13.0 - 14.9	160,641	5,405	5,237	-	10,642	171,283
15.0 - 16.9	128,290	915	3,013	-	3,928	132,218
17.0 - 18.9	93,147	639	6,383	-	7,022	100,169
19.0 - 20.9	65,669	844	5,708	-	6,552	72,221
21.0 - 22.9	45,020	126	6,444	-	6,570	51,591
23.0 - 24.9	28,878	-	3,705	-	3,705	32,583
25.0 - 26.9	18,853	63	2,299	-	2,363	21,215
27.0 - 28.9	14,597	76	2,844	-	2,920	17,517
29.0+	28,382	-	3,875	-	3,875	32,257
All Classes	1,662,066	45,604	48,849	449	94,902	1,756,968

Table 63. Net volume of sawtimber on commercial timberland by diameter class, species, and ownership group, Working Circle 3 (thousand board feet Scribner).

Diameter Class	Softwood Species						Whitebark-limber pine
	Douglas-fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Spruce	
	-----thousand board feet-----						
9.0 - 10.9	37,560	67,392	4,848	45	5,566	3,976	8,502
11.0 - 12.9	58,251	60,282	10,243	304	6,516	2,877	5,447
13.0 - 14.9	45,726	30,026	11,854	458	2,789	4,455	3,757
15.0 - 16.9	43,726	19,124	10,134	1,412	2,078	5,790	3,613
17.0 - 18.9	38,235	7,075	8,469	1,429	797	3,830	1,471
19.0 - 20.9	28,932	2,252	5,135	135	1,045	2,068	2,307
21.0 - 22.9	23,469	737	4,802	1,197	226	2,794	1,429
23.0 - 24.9	20,449	33	2,196	-	268	727	373
25.0 - 26.9	13,788	32	3,316	-	-	1,164	478
27.0 - 28.9	8,942	-	1,585	597	-	771	-
29.0+	14,480	34	3,711	-	-	654	334
All Classes	333,558	186,986	66,294	5,577	19,285	29,106	27,710

Hardwood Species

Diameter Class	Total Softwood Species	Other Hardwoods			Total Hardwood Species	Total All Species
		Aspen	Cottonwood	hardwoods		
	-----thousand board feet-----					
9.0 - 10.9	127,888	-	-	-	-	127,888
11.0 - 12.9	143,920	3,856	2,989	174	7,018	150,939
13.0 - 14.9	99,066	1,587	3,732	-	5,319	104,384
15.0 - 16.9	85,878	278	1,775	-	2,053	87,931
17.0 - 18.9	61,305	233	3,857	-	4,090	65,395
19.0 - 20.9	41,875	334	3,438	-	3,771	45,646
21.0 - 22.9	34,653	34	3,748	-	3,783	38,436
23.0 - 24.9	24,045	-	2,011	-	2,011	26,056
25.0 - 26.9	18,778	17	1,298	-	1,315	20,092
27.0 - 28.9	11,895	20	1,672	-	1,692	13,587
29.0+	19,214	-	2,366	-	2,366	21,580
All Classes	668,516	6,359	26,885	174	33,418	701,934

Table 63.

(Page 2)

Forest Industry

Diameter Class	Softwood Species					Whitebark-	
	Douglas-	Lodgepole	Ponderosa	Western	Subalpine	Spruce	limber
	fir	pine	pine	larch	fir		pine
	-----thousand board feet-----						
9.0 - 10.9	73,831	68,220	4,728	5,623	7,413	3,649	8,401
11.0 - 12.9	105,967	53,684	7,532	3,606	9,840	3,480	5,323
13.0 - 14.9	100,086	35,187	7,806	4,071	4,377	4,818	3,202
15.0 - 16.9	91,841	18,519	15,262	1,378	2,412	5,382	3,687
17.0 - 18.9	80,995	4,405	8,605	1,761	1,182	3,277	1,898
19.0 - 20.9	55,265	1,758	17,316	4,851	1,411	2,197	2,364
21.0 - 22.9	29,453	970	8,010	1,583	336	2,244	1,189
23.0 - 24.9	21,322	-	4,653	3,781	398	564	484
25.0 - 26.9	15,195	-	2,264	2,506	-	1,217	511
27.0 - 28.9	19,393	-	1,964	859	-	265	-
29.0+	27,858	-	1,418	747	-	666	358
All Classes	621,205	182,741	79,558	30,765	27,369	27,759	27,416

Hardwood Species

Diameter Class	Total Softwood Species	Hardwood Species			Total Hardwood Species	Total All Species
	Aspen	Cottonwood	Other hardwoods			
	-----thousand board feet-----					
9.0 - 10.9	171,865	-	-	-	-	171,865
11.0 - 12.9	189,432	166	197	34	396	189,828
13.0 - 14.9	159,547	163	447	-	610	160,157
15.0 - 16.9	138,480	9	129	-	138	138,619
17.0 - 18.9	102,123	93	765	-	859	102,981
19.0 - 20.9	85,162	68	280	-	348	85,510
21.0 - 22.9	43,784	-	684	-	684	44,468
23.0 - 24.9	31,201	-	223	-	223	31,424
25.0 - 26.9	21,694	-	128	-	128	21,822
27.0 - 28.9	22,480	-	92	-	92	22,572
29.0+	31,046	-	167	-	167	31,213
All Classes	996,814	500	3,113	34	3,646	1,000,460

Table 63.

(Page 3)

Other Private

Diameter Class	Softwood Species					Whitebark-	
	Douglas-	Lodgepole	Ponderosa	Western	Subalpine	Spruce	limber
	fir	pine	pine	larch	fir		pine
	-----thousand board feet-----						
9.0 - 10.9	207,981	200,114	25,377	971	19,865	17,436	26,898
11.0 - 12.9	291,978	180,500	43,470	-	23,526	16,942	17,616
13.0 - 14.9	229,539	100,321	56,688	-	7,549	25,900	11,680
15.0 - 16.9	204,365	58,487	55,313	-	8,111	17,107	11,392
17.0 - 18.9	170,207	27,957	46,733	867	2,948	17,515	5,099
19.0 - 20.9	105,031	10,144	41,450	915	3,663	17,634	7,842
21.0 - 22.9	94,841	3,094	32,123	-	838	8,422	4,101
23.0 - 24.9	69,901	1,519	12,824	-	992	3,104	1,278
25.0 - 26.9	38,805	852	7,790	-	-	6,088	1,478
27.0 - 28.9	26,979	-	7,312	875	-	4,568	-
29.0+	63,961	1,567	23,988	-	-	7,248	1,035
All Classes	1,503,587	584,555	353,067	3,628	67,493	141,965	88,420

Hardwood Species

Diameter Class	Total	Total			Total	
	Softwood	Aspen	Cottonwood	Other hardwoods	Hardwood Species	All Species
	Species					
-----thousand board feet-----						
9.0 - 10.9	498,641	-	-	-	-	498,641
11.0 - 12.9	574,033	46,512	17,931	523	64,966	638,999
13.0 - 14.9	431,676	22,258	18,366	-	40,624	472,300
15.0 - 16.9	354,775	3,695	10,858	-	14,553	369,328
17.0 - 18.9	271,326	2,475	22,316	-	24,791	296,117
19.0 - 20.9	186,680	3,255	19,890	-	23,145	209,825
21.0 - 22.9	143,420	495	21,677	-	22,172	165,592
23.0 - 24.9	89,618	-	12,598	-	12,598	102,216
25.0 - 26.9	55,013	246	7,729	-	7,975	62,988
27.0 - 28.9	39,735	294	9,735	-	10,029	49,763
29.0+	97,798	-	13,365	-	13,365	111,163
All Classes	2,742,715	79,229	154,464	523	234,217	2,976,932

Table 63.
(Page 4)

Working Circle Total

Softwood Species

Diameter Class	Softwood Species					Whitebark-	
	Douglas- fir	Lodgepole pine	Ponderosa pine	Western larch	Subalpine fir	Spruce	limber pine
	-----thousand board feet-----						
9.0 - 10.9	319,371	335,726	34,953	6,639	32,843	25,061	43,800
11.0 - 12.9	456,195	294,467	61,246	3,910	39,882	23,299	28,386
13.0 - 14.9	375,351	165,534	76,348	4,528	14,716	35,173	18,639
15.0 - 16.9	339,932	96,129	80,709	2,790	12,602	28,280	18,692
17.0 - 18.9	289,436	39,437	63,806	4,057	4,927	24,623	8,468
19.0 - 20.9	189,228	14,154	63,901	5,902	6,119	21,899	12,514
21.0 - 22.9	147,763	4,801	44,935	2,780	1,400	13,460	6,719
23.0 - 24.9	111,673	1,551	19,672	3,781	1,658	4,395	2,135
25.0 - 26.9	67,789	884	13,370	2,506	-	8,469	2,467
27.0 - 28.9	55,313	-	10,861	2,331	-	5,604	-
29.0+	106,298	1,601	29,117	747	-	8,567	1,727
All Classes	2,458,350	954,283	498,919	39,970	114,147	198,829	143,546

Hardwood Species

Diameter Class	Total Softwood Species	Hardwood Species			Total Hardwood Species	Total All Species
		Aspen	Cottonwood	Other hardwoods		
	-----thousand board feet-----					
9.0 - 10.9	798,393	-	-	-	-	798,393
11.0 - 12.9	907,385	50,534	21,116	731	72,380	979,766
13.0 - 14.9	690,289	24,008	22,545	-	46,553	736,842
15.0 - 16.9	579,133	3,982	12,763	-	16,744	595,878
17.0 - 18.9	434,754	2,802	26,938	-	29,740	464,494
19.0 - 20.9	313,717	3,657	23,608	-	27,265	340,981
21.0 - 22.9	221,858	530	26,109	-	26,639	248,496
23.0 - 24.9	144,865	-	14,832	-	14,832	159,697
25.0 - 26.9	95,485	263	9,155	-	9,418	104,902
27.0 - 28.9	74,109	314	11,499	-	11,813	85,922
29.0+	148,057	-	15,898	-	15,898	163,956
All Classes	4,408,044	86,088	184,462	731	271,281	4,679,326

Table 64. Net volume of sawtimber on commercial softwood timberland by stand size class, timberland quality class, and ownership group, Working Circle 3 (thousand board feet Scribner).

Ownership Group and Stand Size Class	Timberland Quality Class				
	Excellent	Good	Fair	Poor	Total
State and Other Public	-----thousand board feet-----				
Old growth sawtimber	48,066	98,389	107,921	57,375	311,751
Young growth sawtimber	26,081	157,002	54,988	18,947	257,018
Poletimber	7,980	40,329	33,131	1,908	83,347
Seedlings and saplings	10	8,412	4,938	2,941	16,302
Nonstocked	513	-	401	16	930
Total	82,650	304,132	201,379	81,188	669,348
Forest Industry					
Old growth sawtimber	95,063	183,490	179,842	162,710	621,104
Young growth sawtimber	5,131	226,911	10,893	26,123	269,058
Poletimber	7,827	48,089	18,764	1,137	75,817
Seedlings and saplings	-	10,512	5,459	10,455	26,426
Nonstocked	398	-	9	-	408
Total	108,419	469,002	214,967	200,425	992,813
Other Private					
Old growth sawtimber	103,999	317,776	365,009	238,792	1,025,575
Young growth sawtimber	65,399	779,157	383,332	76,050	1,303,939
Poletimber	17,475	143,027	143,034	10,439	313,974
Seedlings and saplings	681	25,063	27,137	15,334	68,214
Nonstocked	10,512	-	3,066	742	14,320
Total	198,067	1,265,023	921,577	341,357	2,726,023
Working Circle Total					
Old growth sawtimber	247,128	599,654	652,772	458,876	1,958,431
Young growth sawtimber	96,611	1,163,070	449,213	121,121	1,830,015
Poletimber	33,281	231,445	194,928	13,484	473,138
Seedlings and saplings	692	43,987	37,533	28,730	110,942
Nonstocked	11,423	-	3,476	758	15,657
Total	389,136	2,038,156	1,337,923	622,969	4,388,183

Table 65. Ratio of net board foot Scribner to net cubic foot volume by diameter class and softwood species commercial timberland, Working Circle 3.

Diameter Class	Species							Total Softwood Species
	Douglas- fir	Lodgepole pine	Ponderosa pine	Subalpine fir	Whitebark- limber pine	Spruce	Western larch	
9.0 - 10.9	2.5	3.4	1.7	3.1	3.2	3.5	3.2	2.9
11.0 - 12.9	3.5	4.8	2.9	4.2	4.4	4.4	4.1	3.9
13.0 - 14.9	4.2	4.9	3.8	4.4	4.6	4.5	4.7	4.3
15.0 - 16.9	4.5	4.9	4.2	4.5	4.7	4.6	4.8	4.5
17.0 - 18.9	4.7	4.9	4.5	4.6	4.6	4.6	5.2	4.7
19.0 - 20.9	4.8	4.8	4.8	4.6	4.7	4.6	5.1	4.8
21.0 - 22.9	5.0	4.9	4.8	4.6	4.8	4.7	5.3	4.9
23.0 - 24.9	5.0	4.9	5.0	5.0	4.9	4.7	5.4	5.0
25.0 - 26.9	5.1	5.0	5.1	-	4.9	4.9	5.6	5.1
27.0 - 28.9	5.1	-	4.9	-	-	5.2	5.6	5.1
29.0+	<u>5.1</u>	<u>5.0</u>	<u>5.4</u>	<u>-</u>	<u>5.0</u>	<u>5.5</u>	<u>5.5</u>	<u>5.2</u>
Total sawtimber (all trees 9.0"+ d.b.h.)	4.0	4.2	3.8	3.9	4.1	4.5	4.6	4.0
Total growing stock (all trees 5.0"+ d.b.h)	3.0	1.9	3.2	1.9	2.7	3.8	3.6	2.7

Table 66. Average d.b.h. age by diameter class, species group, and M.A.I. site class for growing stock trees on commercial timberland, Working Circle 3 (years).

Species Group:		M.A.I. Site Class (ft³/acre/year)					
		20-49		50-84		85+	
		-----years-----					
Diameter Class	Age	Range	Age	Range	Age	Range	
1.0 - 2.9*	58	21-110	58	21-100	54	41- 70	
3.0 - 4.9	61	21-140	72	21-170	53	41- 70	
5.0 - 6.9	80	21-190	81	21-200	76	41-130	
7.0 - 8.9	85	31-200	89	31-200	91	41-180	
9.0 - 10.9	89	31-200	99	31-200	97	41-200	
11.0 - 12.9	103	31-200	105	41-200	112	61-200	
13.0 - 14.9	115	41-200	114	41-200	123	61-200	
15.0 - 16.9	119	41-200	131	51-200	132	71-200	
17.0 - 18.9	133	51-200	136	41-200	142	71-200	
19.0 - 20.9	154	81-200	142	41-200	144	91-200	
21.0 - 22.9	159	81-200	154	51-200	126	71-200**	
23.0 - 24.9	177	121-200	176	71-200	134	81-200**	
25.0 - 26.9	168	101-200**	181	81-200	155	121-200**	
27.0 - 28.9	160	111-200**	178	71-200**	113	91-200**	
29.0 - 30.9	141	131-160**	192	131-200**	166	81-200**	
31.0 - 32.9	195	191-200**	194	151-200**	-	-	
33.0 - 34.9	195	191-200**	188	131-200**	195	191-200**	
35.0 - 36.9	160	121-200**	195	191-200**	135	131-140**	
37.0 - 38.9	-	-	195	191-200**	-	-	
39.0+	195	191-200**	195	191-200**	-	-	
Species Group: Lodgepole pine							
1.0 - 2.9*	51	11- 80	62	21-140	49	31- 70	
3.0 - 4.9	77	21-150	71	31-140	64	41-110	
5.0 - 6.9	90	31-200	85	21-200	63	31-110	
7.0 - 8.9	106	31-200	101	31-200	81	31-190	
9.0 - 10.9	121	41-200	110	41-200	92	41-200	
11.0 - 12.9	125	51-200	122	51-200	95	61-200	
13.0 - 14.9	130	51-200	129	61-200	104	81-170	
15.0 - 16.9	150	111-200	130	51-200	120	81-180**	
17.0 - 18.9	156	111-180**	138	61-200	118	81-170**	
19.0 - 20.9	130	111-150**	159	81-200**	145	141-150**	
21.0 - 22.9	-	-	190	181-200**	115	111-120**	
23.0 - 24.9	115	111-120**	-	-	-	-	
25.0 - 26.9	-	-	105	101-110**	-	-	
27.0 - 28.9	-	-	-	-	-	-	
29.0 - 30.9	-	-	-	-	-	-	
31.1 - 32.9	-	-	-	-	-	-	
33.0 - 34.9	165	161-170**	-	-	-	-	
35.0 - 36.9	-	-	-	-	-	-	
37.0 - 38.9	-	-	-	-	-	-	
39.0+	-	-	-	-	-	-	

*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

**Indicates a very small sample is responsible for the estimates.

Table 66.

(Page 2)

Species Group:

M.A.I. Site Class

(ft³/acre/year)

Western larch,

20-49

50-84

85+

Ponderosa pine

Diameter Class	-----years-----					
	Age	Range	Age	Range	Age	Range
1.0 - 2.9*	49	21- 70	40	21- 60	35	31- 40
3.0 - 4.9	64	31- 90	51	21- 80	-	-
5.0 - 6.9	69	41-140	68	21-120	63	51- 80
7.0 - 8.9	78	31-150	69	21-110	79	61-130
9.0 - 10.9	82	31-160	86	41-180	85	61-140
11.0 - 12.9	92	41-200	93	41-180	76	51-110
13.0 - 14.9	117	51-200	99	31-200	97	61-140
15.0 - 16.9	130	41-200	90	51-200	116	51-180
17.0 - 18.9	142	61-200	119	71-200	97	71-150**
19.0 - 20.9	145	81-200	127	61-200	118	61-200**
21.0 - 22.9	172	71-200**	150	61-200	116	71-200**
23.0 - 24.9	172	141-200**	136	71-200**	76	61-90**
25.0 - 26.9	193	181-200**	161	81-200**	96	71-200**
27.0 - 28.9	195	191-200**	182	121-200**	155	151-160**
29.0 - 30.9	168	121-200**	182	151-200**	-	-
31.0 - 32.9	195	191-200**	175	171-180**	151	91-200**
33.0 - 34.9	195	191-200**	-	-	85	81- 90**
35.0 - 36.9	-	-	195	191-200**	195	191-200**
37.0 - 38.9	-	-	-	-	175	171-180**
39.0+	195	191-200**	195	191-200**	-	-

Species Group: Subalpine fir, Spruce

1.0 - 2.9*	56	31-100	69	41-140	105	61-150**
3.0 - 4.9	57	31- 80	63	31-100	79	51- 90**
5.0 - 6.9	71	41-190	84	41-190	136	41-200**
7.0 - 8.9	87	51-200	99	51-200	148	41-200**
9.0 - 10.9	116	61-200	112	61-200	112	51-200**
11.0 - 12.9	154	91-200	118	61-180	158	81-200**
13.0 - 14.9	116	71-190**	121	61-200	176	51-200**
15.0 - 16.9	169	141-200**	143	81-200	170	51-200**
17.0 - 18.9	195	191-200**	161	91-200	171	91-200**
19.0 - 20.9	195	191-200**	159	91-200	195	191-200**
21.0 - 22.9	195	191-200**	179	91-200**	195	191-200**
23.0 - 24.9	-	-	170	141-200**	-	-
25.0 - 26.9	185	181-190**	191	171-200**	195	191-200**
27.0 - 28.9	-	-	195	191-200**	85	81- 90**
29.0 - 30.9	-	-	195	191-200**	-	-
31.0 - 32.9	-	-	-	-	-	-
33.0 - 34.9	-	-	195	191-200**	-	-
35.0 - 36.9	-	-	-	-	-	-
37.0 - 38.9	-	-	-	-	-	-
39.0+	-	-	195	191-200**	-	-

*Ages recorded for the 2 inch diameter class are total tree ages. All other diameter classes have d.b.h. age recorded for them.

**Indicates a very small sample is responsible for the estimates.

Table 67. Area of commercial timberland by primary habitat type and M.A.I. site class, Working Circle 3 (thousand acres).

Habitat Type	Site Class (Ft ³ /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
Scree	13.3	1.0	-	-	-	14.3
PIFL/AGSP	13.3	-	-	-	-	13.3
PIFL/FEID	18.1	-	3.5	-	-	21.6
PIFL/JUCO	3.6	-	-	-	-	3.6
PIPO	1.0	-	-	-	-	1.0
PIPO/AGSP	11.1	-	-	-	-	11.1
PIPO/FEID	26.2	3.5	1.0	-	-	30.7
PIPO/PUTR	3.5	-	-	-	-	3.5
PIPO/SYAL	7.2	-	-	-	-	7.2
PSME	16.8	13.4	-	-	-	30.2
PSME/AGSP	38.3	16.3	4.6	-	-	59.2
PSME/FEID	74.7	23.6	-	-	-	98.3
PSME/FESC	20.7	15.7	-	-	-	36.4
PSME/VACA	2.4	23.6	7.3	-	-	33.4
PSME/PHMA	8.7	20.0	3.5	3.5	-	35.6
PSME/VAGL	11.2	17.3	-	0.4	-	29.0
PSME/LIBO	5.1	51.3	2.4	-	-	58.8
PSME/SYAL	47.4	104.6	14.9	-	-	166.8
PSME/CARU	85.7	89.8	7.2	-	-	182.8
PSME/CAGE	11.0	6.7	-	-	-	17.7
PSME/SPBE	-	3.5	-	-	-	3.5
PSME/ARUV	11.1	11.2	-	-	-	22.3
PSME/JUCO	7.3	-	-	-	-	7.3
PSME/ARCO	3.5	-	-	-	-	3.5
PSME/SYOR	-	3.5	-	-	-	3.5
PICEA/EQAR	-	-	1.8	-	-	1.8
PICEA/CLUN	3.6	-	1.1	-	-	4.7
PICEA/GATR	-	3.6	0.4	-	-	4.0
PICEA/VACA	-	1.2	1.0	-	-	2.2
PICEA/SEST	1.6	-	-	-	-	1.6
PICEA/LIBO	7.3	17.0	-	4.4	-	28.7
PICEA/SMST	2.4	3.8	5.4	-	-	11.7
ABLA/CLUN	-	10.3	-	-	-	10.3
ABLA/VACA	-	3.4	-	-	-	3.4
ABLA/CACA	-	7.3	3.6	-	-	10.9
ABLA/LIBO	6.7	19.5	4.5	-	-	30.7
ABLA/XETE	-	11.9	-	-	-	11.9
ABLA/VAGL	-	3.6	-	-	-	3.6
ABLA/VASC	17.9	15.2	-	-	-	33.1
ABLA/CARU	4.9	8.9	3.6	-	-	17.4
ABLA/CLPS	3.8	-	-	-	-	3.8
ABLA/ARCO	3.6	3.6	-	-	-	7.3
ABLA/RIMO	8.4	5.6	-	-	-	14.0
ABLA-PIAL/VASC	-	2.6	-	-	-	2.6
ABLA/LUHI	6.2	-	-	-	-	6.2
PIAL-ABLA	6.2	2.6	-	-	-	8.8
PIAL	6.0	-	-	-	-	6.0

Table 67.

(Page 2)

Habitat Type	Site Class (Ft ³ /Acre/Year)					Total
	20-49	50-84	85-119	120-164	165+	
	-----thousand acres-----					
PICO/VACA	3.6	-	-	-	-	3.6
PICO/VASC	2.6	-	-	-	-	2.6
PICO/CARU	-	3.6	-	-	-	3.6
Hardwoods	22.8	18.6	9.5	-	-	50.9
Total	548.7	547.3	75.7	8.3	-	1,180.0

Table 68. Area of commercial softwood timberland by treatment opportunity group, M.A.I. site class, and ownership group, Working Circle 3 (thousand acres).

State and Other Public		M.A.I. Site Class (ft ³ /acre/year)					Total
Treatment Opportunity Group		20-49	50-84	85-119	120-164	165+	
		-----thousand acres-----					
10		9.8	15.8	1.6	-	-	27.1
11		9.9	16.2	2.9	0.9	-	29.9
12		-	0.5	-	-	-	0.5
13		3.3	2.7	-	-	-	6.0
14		3.4	1.0	-	-	-	4.4
15		-	-	-	-	-	-
20		11.9	3.7	0.5	0.4	-	16.5
21		0.2	4.5	1.0	-	-	5.7
22		3.8	3.6	0.2	-	-	7.7
23		10.7	1.7	0.3	-	-	12.8
30		9.4	14.1	1.3	1.0	-	25.8
32		0.4	-	-	-	-	0.4
33		-	0.1	0.4	-	-	0.5
40		-	0.3	-	-	-	0.3
12, 13		-	-	-	-	-	-
13, 20		1.0	1.6	-	-	-	2.6
13, 20, 23		-	-	-	-	-	-
13, 21		0.6	0.3	-	-	-	0.8
13, 23		1.5	1.1	-	-	-	2.6
13, 33		-	0.9	-	-	-	0.9
20, 23		1.0	0.8	-	-	-	1.8
22, 23		1.0	-	-	-	-	1.0
22, 33		0.4	-	-	-	-	0.4
12, 13, 22		-	-	-	-	-	-
12, 22		-	-	-	-	-	-
13, 20, 22		1.4	0.7	-	-	-	2.0
13, 20, 22, 23		0.1	-	-	-	-	0.1
13, 22		0.9	1.4	-	-	-	2.3
13, 22, 23		-	0.1	-	-	-	0.1
13, 22, 33		-	0.6	-	-	-	0.6
20, 22		2.5	1.4	-	-	-	4.0
20, 22, 23		-	-	-	-	-	-
Total		73.3	72.9	8.2	2.4	-	156.8

Table 68.

(Page 2)

Forest Industry		M.A.I. Site Class (ft ³ /acre/year)					
Treatment	20-49	50-84	85-119	120-164	165+	Total	
Opportunity Group	-----thousand acres-----						
10	9.7	40.3	0.9	3.5	-	54.3	
11	8.8	14.4	6.5	-	-	29.7	
12	-	*	-	-	-	*	
13	1.3	3.5	-	-	-	4.8	
14	0.8	3.4	-	-	-	4.1	
15	-	-	-	-	-	-	
20	2.1	7.7	*	-	-	9.8	
21	-	4.3	1.1	-	-	5.4	
22	0.5	2.9	0.1	-	-	3.5	
23	8.3	7.2	0.4	-	-	15.8	
30	9.4	20.7	3.5	0.4	-	34.0	
32	*	-	-	-	-	*	
33	-	-	*	-	-	*	
40	-	2.4	-	-	-	2.4	
12, 13	-	-	-	-	-	-	
13, 20	0.1	5.9	-	-	-	6.0	
13, 20, 23	-	3.5	-	-	-	3.5	
13, 21	*	-	-	-	-	*	
13, 23	1.2	0.1	-	-	-	1.3	
13, 33	-	*	-	-	-	*	
20, 23	0.9	0.1	-	-	-	1.0	
22, 23	0.1	-	-	-	-	0.1	
22, 33	-	-	-	-	-	-	
12, 13, 22	-	-	-	-	-	-	
12, 22	-	-	-	-	-	-	
13, 20, 22	0.1	1.1	-	-	-	1.2	
13, 20, 22, 23	-	-	-	-	-	-	
13, 22	*	2.5	-	-	-	2.5	
13, 22, 23	-	0.2	-	-	-	0.2	
13, 22, 33	-	0.1	-	-	-	0.1	
20, 22	1.0	*	-	-	-	1.1	
20, 22, 23	-	-	1.2	-	-	1.2	
Total	44.4	120.3	13.7	3.9	-	182.3	

*Indicates less than 50 acres.

Table 68.

(Page 3)

Other Private		M.A.I. Site Class (ft ³ /acre/year)				Total
Treatment	20-49	50-84	85-119	120-164	165+	
Opportunity Group	-----thousand acres-----					
10	59.7	48.8	2.2	-	-	110.6
11	32.0	65.2	13.9	-	-	111.2
12	-	2.9	-	-	-	2.9
13	16.9	26.4	-	-	-	43.3
14	7.3	-	-	-	-	7.3
15	-	-	-	-	-	-
20	61.4	25.4	5.5	-	-	92.4
21	3.4	12.6	3.5	-	-	27.1
22	19.8	12.3	1.5	-	-	33.6
23	73.8	4.3	4.9	-	-	83.0
30	44.0	52.8	5.9	2.1	-	104.7
32	3.2	-	-	-	-	3.2
33	-	3.5	3.2	-	-	6.7
40	-	9.4	-	-	-	9.4
12, 13	-	-	-	-	-	-
13, 20	4.8	3.8	-	-	-	8.7
13, 20, 23	-	-	-	-	-	-
13, 21	5.7	7.0	-	-	-	12.7
13, 23	10.0	13.3	-	-	-	23.2
13, 33	-	6.5	-	-	-	6.5
20, 23	5.4	4.8	-	-	-	10.2
22, 23	6.2	-	-	-	-	6.2
22, 33	-	-	-	-	-	-
12, 13, 22	-	-	-	-	-	-
12, 22	-	-	-	-	-	-
13, 20, 22	13.1	12.6	-	-	-	25.8
13, 20, 22, 23	3.5	-	-	-	-	3.5
13, 22	6.5	3.3	-	-	-	9.7
13, 22, 23	-	0.7	-	-	-	0.7
13, 22, 33	-	3.0	-	-	-	3.0
20, 22	14.8	3.3	-	-	-	18.1
20, 22, 23	-	-	-	-	-	-
Total	391.5	329.5	40.6	2.1	-	763.8

Table 69. Area of commercial softwood timberland by treatment opportunity group, timberland quality class, and ownership group, Working Circle 3 (thousand acres).

Treatment Opportunity Group	Timberland Quality Class				Total
	Excellent	Good	Fair	Poor	
	-----thousand acres-----				
10	1.0	11.3	11.7	3.1	27.1
11	3.8	11.8	9.0	5.2	29.9
12	-	0.5	-	-	0.5
13	-	2.7	3.2	*	6.0
14	-	1.0	3.4	-	4.4
15	-	-	-	-	-
20	0.9	3.0	12.0	0.6	16.5
21	1.0	3.5	1.1	*	5.7
22	0.2	2.6	4.9	-	7.7
23	0.1	1.6	10.5	0.5	12.8
30	1.2	8.9	13.1	2.5	25.8
32	-	-	-	0.4	0.4
33	-	0.1	0.4	-	0.5
40	-	0.3	-	-	0.3
12, 13	-	-	-	-	-
13, 20	-	1.0	1.6	-	2.6
13, 20, 23	-	-	-	-	-
13, 21	-	0.3	0.5	0.1	0.8
13, 23	-	0.6	1.5	0.6	2.6
13, 33	-	0.5	0.4	-	0.9
20, 23	-	0.8	1.0	-	1.8
22, 23	-	-	1.0	-	1.0
22, 33	-	-	0.4	-	0.4
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	-	0.7	1.4	-	2.0
13, 20, 22, 23	-	-	0.1	-	0.1
13, 22	-	1.4	0.9	-	2.3
13, 22, 23	-	0.1	-	-	0.1
13, 22, 33	-	0.6	-	-	0.6
20, 22	-	1.4	2.5	-	4.0
20, 22, 23	-	-	-	-	-
Total	8.2	54.6	80.8	13.2	156.8

*Indicates less than 50 acres.

Table 69.

(Page 2)

Forest Industry

Timberland Quality Class

Treatment Opportunity Group	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
10	3.5	20.5	17.5	12.8	54.3
11	2.9	6.5	10.0	10.3	29.7
12	-	*	-	-	*
13	-	3.5	1.3	-	4.8
14	-	3.4	0.8	-	4.1
15	-	-	-	-	-
20	*	7.6	2.1	0.1	9.8
21	1.1	4.1	0.2	-	5.4
22	0.1	2.5	0.9	-	3.5
23	0.2	4.7	9.8	1.1	15.8
30	3.5	18.6	10.5	1.4	34.0
32	-	-	-	*	*
33	-	-	*	-	*
40	-	2.4	-	-	2.4
12, 13	-	-	-	-	-
13, 20	-	3.4	0.2	2.4	6.0
13, 20, 23	-	3.5	-	-	3.5
13, 21	-	-	*	-	*
13, 23	-	*	1.2	*	1.3
13, 33	-	*	*	-	*
20, 23	-	0.1	0.9	-	1.0
22, 23	-	-	0.1	-	0.1
22, 33	-	-	-	-	-
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	-	1.1	0.1	-	1.2
13, 20, 22, 23	-	-	-	-	-
13, 22	-	2.5	*	-	2.5
13, 22, 23	-	0.2	-	-	0.2
13, 22, 33	-	0.1	-	-	0.1
20, 22	-	*	1.0	-	1.0
20, 22, 23	1.2	-	-	-	1.2
Total	12.6	84.8	56.7	28.3	182.3

*Indicates less than 50 acres.

Table 69.
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Other Private

Timberland Quality Class

Treatment Opportunity Group	Excellent	Good	Fair	Poor	Total
	-----thousand acres-----				
10	-	31.6	62.1	17.0	110.6
11	13.9	52.0	26.2	19.1	111.2
12	-	2.9	-	-	2.9
13	-	26.4	14.5	2.4	43.3
14	-	-	7.3	-	7.3
15	-	-	-	-	-
20	5.5	21.3	63.9	1.7	92.4
21	3.5	14.4	6.7	2.4	27.1
22	1.5	10.2	21.9	-	33.6
23	0.7	3.6	71.9	6.8	83.0
30	2.4	31.3	62.5	8.5	104.7
32	-	-	-	3.2	3.2
33	-	3.5	3.2	-	6.7
40	-	9.4	-	-	9.4
12, 13	-	-	-	-	-
13, 20	-	0.9	7.8	-	8.7
13, 20, 23	-	-	-	-	-
13, 21	-	7.0	3.3	2.5	12.7
13, 23	-	6.8	10.0	6.5	23.2
13, 33	-	3.3	3.2	-	6.5
20, 23	-	4.8	5.4	-	10.2
22, 23	-	-	6.2	-	6.2
22, 33	-	-	-	-	-
12, 13, 22	-	-	-	-	-
12, 22	-	-	-	-	-
13, 20, 22	-	12.6	13.1	-	25.8
13, 20, 22, 23	-	-	3.5	-	3.5
13, 22	-	3.3	6.5	-	9.7
13, 22, 23	-	0.7	-	-	0.7
13, 22, 33	-	3.0	-	-	3.0
20, 22	-	3.3	14.8	-	18.1
20, 22, 23	-	-	-	-	-
Total	27.5	252.4	414.0	69.9	763.8

Table 70. Area of commercial timberland by crown density, condition class, and climax series, Working Circle 3 (thousand acres).

Crown Density and Condition Class	Climax Series							
	Douglas- fir	Subalpine fir	Ponderosa pine	Spruce	Hardwoods thousand acres	Limber pine	Lodgepole pine	Total
Crown Density 0-30								
Excellent	28.8	1.1	5.6	8.5	2.3	9.7	-	56.0
Good	81.9	5.5	11.1	3.6	-	3.5	-	105.7
Fair	52.4	3.6	3.8	2.4	1.6	-	3.6	67.5
Poor	11.1	-	3.6	-	-	-	-	14.7
Total	174.1	10.2	24.1	14.6	4.0	13.2	3.6	243.8
Crown Density 31-50								
Excellent	99.0	6.9	3.6	-	10.7	7.2	2.6	130.0
Good	103.7	15.1	10.9	5.2	6.8	3.8	-	145.5
Fair	21.8	5.2	10.8	-	-	7.2	-	44.9
Poor	0.9	-	-	-	-	-	-	0.9
Total	225.3	27.1	25.3	5.2	17.5	18.1	2.6	321.3
Crown Density 51-70								
Excellent	106.8	40.1	7.4	8.8	-	-	-	163.1
Good	89.0	19.0	-	8.8	5.4	3.6	3.6	129.5
Fair	24.3	9.9	-	3.6	-	-	-	37.8
Poor	2.6	2.3	6.1	-	-	-	-	11.0
Total	222.6	71.3	13.5	21.2	5.4	3.6	3.6	341.4
71+ Crown Density	166.1	61.3	4.8	13.8	23.9	3.6	-	273.5
Totals for All Crown Densities								
Excellent	234.6	48.1	16.7	17.3	13.0	16.9	2.6	349.1
Good	274.5	39.7	22.1	17.6	12.3	10.9	3.6	380.7
Fair	98.4	18.7	14.5	6.1	1.6	7.2	3.6	150.1
Poor	14.6	2.3	9.7	-	-	-	-	26.6
71+ Crown Density	166.1	61.3	4.8	13.8	23.9	3.6	-	273.5
Total	788.3	170.0	67.7	54.8	50.9	38.6	9.8	1,180.0

Table 71. Available animal unit months (AUM's) on commercial timberland by crown density, condition class, and climax series, Working Circle 3.

Crown Density and Condition Class	Climax Series							
	Douglas- fir	Subalpine fir	Ponderosa pine	Spruce	Hardwoods	Limber pine	Lodgepole pine	Total
-----AUM's-----								
Crown Density 0-30								
Excellent	6,030	481	2,048	3,654	2,273	1,903	-	16,389
Good	17,468	1,602	2,868	981	-	783	-	23,702
Fair	8,156	1,079	717	482	408	-	889	11,731
Poor	1,441	-	172	-	-	-	-	1,613
Total	33,095	3,162	5,805	5,117	2,681	2,686	889	53,435
Crown Density 31-50								
Excellent	17,054	1,146	900	-	4,747	720	348	24,915
Good	12,605	1,276	1,731	269	2,312	255	-	18,448
Fair	1,557	213	746	-	-	759	-	3,274
Poor	303	-	-	-	-	-	-	303
Total	31,519	2,635	3,377	269	7,059	1,734	348	46,941
Crown Density 51-70								
Excellent	11,232	2,562	559	756	-	-	-	15,110
Good	7,541	856	-	676	809	436	520	10,839
Fair	1,166	283	-	173	-	-	-	1,621
Poor	-	1	-	-	-	-	-	1
Total	19,939	3,702	559	1,605	809	436	520	27,570
Crown Density 71+	-	-	-	-	61	-	-	61
Totals For All Crown Densities								
Excellent	34,316	4,189	3,507	4,410	7,020	2,623	348	56,414
Good	37,614	3,734	4,599	1,926	3,121	1,474	520	52,989
Fair	10,879	1,575	1,463	655	408	759	889	16,626
Poor	1,744	1	172	-	-	-	-	1,917
71+ Crown Density	-	-	-	-	61	-	-	61
Total	84,553	9,499	9,741	6,991	10,610	4,856	1,757	128,008

Table 72. Potential animal unit months (AUM's) on commercial timberland by crown density and climax series, Working Circle 3.

Crown Density	Climax Series							Total
	Douglas-fir	Subalpine fir	Ponderosa pine	Spruce	Hardwoods	Limber pine	Lodgepole pine	
	-----AUM's-----							
0 - 30	51,922	4,502	8,358	6,211	1,964	2,947	1,778	77,681
31 - 50	43,250	3,510	4,866	449	7,973	2,959	348	63,355
51 - 70	22,739	3,922	262	2,110	1,079	436	693	31,242
Total	117,911	11,933	13,486	8,770	11,015	6,342	2,819	172,277

Table 73. Area of commercial timberland by forest type, fuel loads per acre, and ownership group, Working Circle 3 (thousand acres).

Ownership Group and Forest Type	Fuel Loads in Tons Per Acre			Total
	0 to 10.0	10.1 to 25.0	25.1+	
	-----thousand acres-----			
State and Other Public				
Douglas-fir	36.5	33.0	17.3	86.8
Lodgepole pine	9.8	6.5	17.4	33.8
Ponderosa pine	11.5	7.0	0.5	19.0
Other softwoods	5.5	3.4	8.3	17.1
Total softwoods	63.2	49.9	43.7	156.8
Total hardwoods	2.3	5.8	0.5	8.6
Total all types	65.5	55.6	44.1	165.4
Forest Industry				
Douglas-fir	32.7	36.9	43.6	113.1
Lodgepole pine	8.3	12.1	18.6	39.0
Ponderosa pine	4.9	4.2	*	9.1
Other softwoods	2.7	8.1	10.4	21.1
Total softwoods	48.6	61.3	72.6	182.3
Total hardwoods	2.7	1.7	0.2	4.6
Total all types	51.4	63.0	72.8	186.9
Other Private				
Douglas-fir	179.9	171.9	103.5	455.3
Lodgepole pine	40.5	18.5	61.1	120.2
Ponderosa pine	67.2	38.5	5.6	111.3
Other softwoods	22.6	13.0	41.0	77.0
Total softwoods	310.2	242.4	211.3	763.7
Total hardwoods	11.5	46.6	6.0	63.9
Total all types	321.6	288.9	217.3	827.7
Working Circle Total				
Douglas-fir	249.1	241.7	164.4	655.2
Lodgepole pine	58.6	37.1	97.2	193.0
Ponderosa pine	83.5	49.8	6.2	139.5
Other softwoods	30.7	25.0	59.6	115.2
Total softwoods	421.9	353.4	327.5	1,102.9
Total hardwoods	16.5	54.1	6.6	77.1
Total all types	438.5	407.4	334.1	1,180.0

Table 74. Area of commercial timberland by salvable dead volume class and ownership group, Working Circle 3 (thousand acres).

Volume Class (net cubic feet per acre)	Ownership Group			Total	Percentage of Total
	State and Other Public	Forest Industry	Other Private		
	-----thousand acres-----				
None	77.1	81.6	437.2	595.9	50.5
1 - 100	41.6	32.5	186.2	260.3	22.1
101 - 200	20.7	33.9	91.8	146.4	12.4
201 - 300	10.1	14.9	50.1	75.2	6.4
301 - 400	5.4	9.6	27.9	42.9	3.6
401 - 500	0.5	7.4	1.5	9.5	0.8
501 - 600	4.8	1.8	14.5	21.1	1.8
601 - 700	0.7	0.9	5.6	7.2	0.6
701 - 800	0.6	0.9	2.2	3.6	0.3
801 - 900	0.6	0.9	2.2	3.6	0.3
901 - 1,000	-	-	-	-	-
1,001 - 1,100	1.0	0.4	2.1	3.5	0.3
1,101 - 1,200	0.6	0.9	2.2	3.6	0.3
1,201 - 1,300	-	-	-	-	-
1,301 - 1,400	-	-	-	-	-
1,401 - 1,500	-	-	-	-	-
1,501 - 1,600	-	-	-	-	-
1,601 - 1,700	1.0	0.4	2.1	3.5	0.3
1,701 - 1,800	-	-	-	-	-
1,801 - 1,900	-	-	-	-	-
1,901 - 2,000	-	-	-	-	-
2,001 - 2,100	-	-	-	-	-
2,101 - 2,200	-	-	-	-	-
2,201 - 2,300	0.6	0.9	2.2	3.6	0.3
2,301+	-	-	-	-	-
Total	165.4	186.9	827.7	1,180.0	100.0

Table 75. Net volume of salvable dead by diameter class and condition of dead class for commercial softwood species, Working Circle 3 (thousand cubic feet).

Condition of Dead Class

Diameter Class	Defect--Mostly		Defect--Mostly	Total
	No Defect	Physical	Rot	
	-----thousand cubic feet-----			
5.0 - 6.9	7,729	1,484	12,529	21,742
7.0 - 8.9	7,381	1,469	18,350	27,199
9.0 - 10.9	1,858	3,025	10,287	15,170
11.0 - 12.9	1,272	3,889	10,045	15,206
13.0 - 14.9	677	1,544	8,447	10,668
15.0 - 16.9	313	874	4,687	5,874
17.0 - 18.9	75	-	3,897	3,971
19.0 - 20.9	58	208	2,640	2,905
21.0 - 22.9	134	335	1,707	2,176
23.0 - 24.9	-	-	1,604	1,604
25.0 - 26.9	79	-	718	797
27.0 - 28.9	322	-	498	820
29.0+	-	-	1,545	1,545
Total	19,897	12,829	76,952	109,677

Table 76. Net volume of salvable dead on commercial timberland by ownership group and condition of dead, Working Circle 3 (thousand cubic feet).

Condition of Dead Class

Ownership Group	Defect-- Mostly		Defect--Mostly	Total
	No Defect	Physical	Rot	
	-----thousand cubic feet-----			
State and Other Public	1,788	2,455	14,401	18,643
Forest Industry	6,033	2,026	15,901	23,960
Other Private	12,076	9,189	52,032	73,296
Working Circle Total	19,897	13,670	82,333	115,900

Table 77. Net volume of salvable dead on commercial timberland by forest type and condition of dead class, Working Circle 3 (thousand cubic feet).

Condition of Dead Class

Forest Type	No Defect		Defect-- Mostly Physical		Defect-- Mostly Rot		Total
	Standing	Down	Standing	Down	Standing	Down	
	-----thousand cubic feet-----						
Douglas-fir	9,609	1,259	3,108	1,229	15,668	7,381	38,254
Lodgepole pine	6,951	1,050	5,406	-	19,951	11,170	44,527
Ponderosa pine	401	306	211	95	1,024	688	2,724
Western larch	-	-	-	-	70	107	177
Remaining softwood types	56	265	1,380	1,344	12,848	8,178	24,072
Hardwood types	-	-	827	70	3,501	1,747	6,145
Total	17,017	2,880	10,932	2,738	53,062	29,271	115,899

Table 78. Net volume of nonsalvable dead by diameter class and ownership group on commercial timberland, Working Circle 3 (thousand cubic feet).

Ownership Group

Diameter Class	State and	Forest	Other	Total
	Other Public	Industry	Private	
	-----thousand cubic feet-----			
5.0 - 6.9	337	177	1,208	1,723
7.0 - 8.9	282	592	1,177	2,051
9.0 - 10.9	610	761	2,148	3,518
11.0 - 12.9	526	661	1,952	3,139
13.0 - 14.9	283	367	1,549	2,199
15.0 - 16.9	155	390	935	1,479
17.0 - 18.9	314	545	1,167	2,026
19.0 - 20.9	229	782	1,021	2,032
21.0 - 22.9	137	408	567	1,112
23.0 - 24.9	206	356	434	995
25.0 - 26.9	198	282	521	1,001
27.0 - 28.9	89	165	476	730
29.0+	575	389	1,145	2,109
Total	3,941	5,873	14,299	24,114

Table 79. Number of softwood and hardwood trees on commercial timberland by tree class, salvable dead, and ownership group, Working Circle 3 (thousand trees).

Ownership Group and Tree Class		Species					
State and Other Public	Softwoods		Hardwoods		Total		
	# trees	%	# trees	%	# trees	%	
	-----thousand trees-----						
Desirable	36,073	36.2	913	36.6	36,987	36.3	
Acceptable	44,629	44.9	1,277	51.1	45,905	45.0	
Sound cull	15,498	15.6	36	1.4	15,534	15.2	
Rotten cull	76	0.1	16	0.7	92	0.1	
Salvable dead*	3,180	3.2	255	10.2	3,435	3.4	
Total	99,457	100.0	2,497	100.0	101,954	100.0	
Forest Industry							
Desirable	32,283	28.7	588	65.2	32,871	29.0	
Acceptable	58,435	51.9	289	32.1	58,724	51.8	
Sound cull	17,702	15.7	**	***	17,702	15.6	
Rotten cull	198	0.2	2	0.2	199	0.2	
Salvable dead*	3,880	3.5	23	2.5	3,903	3.4	
Total	112,498	100.0	902	100.0	113,400	100.0	
Other Private							
Desirable	168,903	39.4	5,554	35.2	174,457	39.2	
Acceptable	175,760	41.0	8,561	54.3	184,321	41.5	
Sound cull	70,952	16.5	347	2.2	71,299	16.0	
Rotten cull	794	0.2	160	1.0	954	0.2	
Salvable dead*	12,476	2.9	1,153	7.3	13,629	3.1	
Total	428,884	100.0	15,776	100.0	444,660	100.0	
Working Circle Totals							
Desirable	237,260	37.0	7,056	36.8	244,315	37.0	
Acceptable	278,823	43.5	10,127	52.8	288,950	43.8	
Sound cull	104,152	16.2	383	2.0	104,535	15.8	
Rotten cull	1,068	0.2	178	0.9	1,246	0.2	
Salvable dead*	19,536	3.1	1,431	7.5	20,967	3.2	
Total	640,839	100.0	19,175	100.0	660,013	100.0	

*The number of salvable dead trees includes only those trees with a d.b.h. of 5.0 inches and larger. The number of live trees by tree class includes all trees 1.0 inches at d.b.h. and larger.

**Indicates less than 500 trees.

***Indicates less than 0.05%

APPENDIX 4. WOOD PROCESSORS IN WORKING CIRCLE 3.

Table 80. Sawmills in Working Circle 3.

<u>COMPANY</u>	<u>ANNUAL PRODUCTION</u>	<u>SPECIES PROCESSED</u>	<u>PRODUCTS MANUFACTURED</u>
BEAVERHEAD COUNTY			
<u>Dillon</u>			
F.H. Stoltze Land and Lumber Company	10-25 MMBF	DF LPP ES WF	Dimension 1" Boards Rough and Surfaced
R & V Log and Lumber	Less than 3 MMBF	DF LPP	Dimension 1" Boards Timbers Studs Ties
<u>Wisdom</u>			
Lee Kirkpatrick	Less than 3 MMBF		Portable Sawmill
Wilke Brother's Sawmill	3-5 MMBF	DF LPP ES	Dimension 1" Boards Rough and Surfaced Timbers
BROADWATER COUNTY			
<u>Townsend</u>			
Dewey Cooper	Less than 3 MMBF	DF PP LPP	Timbers Ties Rough
Wickes Forest Industries	10-25 MMBF	DF ES LPP	Dimension Studs Surfaced
GRANITE COUNTY			
<u>Philipsburg</u>			
Granite Timber Treating	Less than 3 MMBF		
<u>Hall</u>			
Hall/Alt Lumber Co.	3-5 MMBF		
Magera Lumber	3-5 MMBF	Studs	
Sorenson Brothers Lumber Co.	Less than 3 MMBF		1" Boards Dimension Rough

*Information obtained from the 1983 Directory of Montana's Forest Products Industry, Montana Department of State Lands, Forestry Division.

Table 80.
(Page 2)

<u>COMPANY</u>	<u>ANNUAL PRODUCTION</u>	<u>SPECIES PROCESSED</u>	<u>PRODUCTS MANUFACTURED</u>
JEFFERSON COUNTY			
<u>Boulder</u>			
Barton L. Cooper Sawmill	Less than 3 MMBF		Portable Sawmill
Earl Stagg House Log Operator	Less than 3 MMBF		
LEWIS AND CLARK COUNTY			
<u>Helena</u>			
Champion Building Products	25-50 MMBF	DF PP LPP ES,WF,WL	Studs Ties
E. Klos	Less than 3 MMBF	DF PP LPP	Dimension 1" Boards Rough
Gean Debree	Less than 3 MMBF		Portable Sawmill
Morris Lumber Co.	Less than 3 MMBF		
<u>Wolf Creek</u>	Less than	DF	Studs
R&R Lumber	3 MMBF	PP LPP	Ties Dimension 1" Boards Timbers
<u>East Helena</u>			
Warren Wood Sawmill	Less than 3 MMBF		Part-Time Sawmill
<u>Lincoln</u>			
Woodhurst Lumber	Less than 3 MMBF		
MADISON COUNTY			
<u>McAllister</u>			
Buds Boards		LPP PP	Rough 1" Boards Beams
<u>Sheriden</u>			
DAF Logging			
<u>Twin Bridges</u>			
Iron Rod Sawmill			

Table 80.
(Page 3)

<u>COMPANY</u>	<u>ANNUAL PRODUCTION</u>	<u>SPECIES PROCESSED</u>	<u>PRODUCTS MANUFACTURED</u>
POWELL COUNTY			
<u>Deer Lodge</u> Joe Applegate	Less than 3 MMBF		
<u>Avon</u> Lawrence Beck	Less than 3 MMBF		Dimension
<u>Deer Lodge</u> Louisiana-Pacific Corp.	25-50 MMBF	DF ES LPP	Studs
<u>Avon</u> Soren Beck	Less than 3 MMBF		
SILVER BOW COUNTY			
<u>Butte</u> Arthur Dick Sawmill	Less than 3 MMBF		Ties Timbers
Howard Stratton	Less than 3 MMBF		
Montana Pole & Treating	3-5 MMBF		

Table 81. Post and pole processors in Working Circle 3.

<u>COMPANY</u>	<u>PROCESS USED</u>	<u>PRESERVATIVE USED</u>	<u>PRODUCTS MANUFACTURED</u>
BEAVERHEAD COUNTY			
<u>Wisdom</u> Raymond Weaver Post & Pole			
BROADWATER COUNTY			
<u>Townsend</u> Townsend Post & Pole			
DEER LODGE COUNTY			
<u>Anaconda</u> Anaconda Post & Pole	Thermal-Cold soak --Non-pressure	Penta-oil born	Posts, Poles Peeled & Split Rails & Gates
GRANITE COUNTY			
<u>Porter's Corner</u> Granite Timber Treating			
JEFFERSON COUNTY			
<u>Boulder</u> B.L. Cooper Post Yard			
Gary Marks Post	Cold soak--Non-pressure	Penta-oil born	Posts Poles
<u>Whitehall</u> Pipestone Post & Pole	Thermal--Non-pressure	Penta-oil born	Posts Poles Rails
LEWIS AND CLARK COUNTY			
<u>Lincoln</u> Blackfoot Treating Plant	Thermal--Non-pressure	Penta-oil born	Posts Poles Rails
Bouma Post Yard	Cold soak--Non-pressure	Penta-oil born	
MADISON COUNTY			
<u>Cameron</u> John Gecho Post & Pole			

Table 81.

(Page 2)

<u>COMPANY</u>	<u>PROCESS USED</u>	<u>PRESERVATIVE USED</u>	<u>PRODUCTS MANUFACTURED</u>
POWELL COUNTY			
<u>Elliston</u> Thomas Post Yard	Thermal--Cold soak	Penta-oil born	Posts Poles
SILVER BOW COUNTY			
<u>Butte</u> Montana Pole And Treating Plant	Pressure	Penta-oil born	Posts 1" Boards Ties Poles, Timbers Pilings

Table 82. Log home manufacturers in Working Circle 3.

<u>COMPANY</u>	<u>AVERAGE NUMBER OF HOMES ANNUALLY</u>	<u>SPECIES PROCESSED</u>	<u>TYPE OF LOG HOME</u>
BEAVERHEAD COUNTY			
<u>Dillon</u> Hyland Log Homes			
<u>Wisdom</u> Wilke Bros. Sawmill Incorp.	10	Dead LPP	Tongue & Groove Lap on Outside to Cover Joint.
LEWIS AND CLARK COUNTY			
<u>Lincoln</u> Lincoln Log Cabins	50	Green LPP	Hand Peeled, Sawn 2 Side

APPENDIX 5. DESCRIPTION OF TREATMENT CODES

The purpose of this appendix is to define the stand characteristics which make up each of the fourteen categories. In many cases, a stand may receive more than one treatment code. Under each treatment code description below there is a list of the other codes which may occur in combination with the one being described.

Code 10: Harvest - high risk

Code 10 includes all commercial, non-vigorous, overmature stands, as well as any merchantable stand which exhibits an unmanageable insect or disease problem.

Lodgepole sawtimber stands which are over 100 years old are automatically included.

Possible combinations: None

Code 11: Harvest - low risk

This is a diverse category which includes the following types of stands:

1. All commercial stands older than 100 years which do not qualify as high risk (they are of relatively better vigor than high risk stands). If such a stand is dominated by shade tolerant species, it is included here, regardless of age.
2. All commercial lodgepole stands which are 50-100 years old and non-vigorous, and which have not qualified as high risk.
3. Various other stands containing commercial material which are not manageable because of poor tree quality and vigor.

Possible combinations: None

Code 12: Commercial thinning

This category includes stands which are fully stocked to overstocked with Douglas-fir, western larch, ponderosa or lodgepole pine, and which meet all of the following characteristics:

1. Would yield commercial sawtimber if thinned.
2. Are less than 100 years old.
3. Are currently growing at less than full potential, but are capable of release.
4. Do not exhibit unmanageable insect or disease problems.

Possible combinations: (12, 13), (12, 13, 22), (12, 22).

Code 13: Overstory removal

Code 13 includes any stand which contains commercial size trees in excess of 1,000 b.f. per acre, and which also meets one of the following conditions:

The trees in question are relicts, i.e., not part of the manageable stand component.

The trees in question represent the upper story of a two storied stand, but they are inadequately stocked to be treated as a separate management component.

Possible combinations: (13, 22, 33), (12, 13), (12, 13, 22), (13, 33), (13, 22), (13, 22, 23), (13, 20), (13, 20, 23), (13, 20, 22, 23), (13, 23), (13, 21).

Code 14: Two storied stand (overstory, harvest - high risk; understory, manageable)

This category is made up of two storied sawtimber stands meeting the requirements of treatment code 10. The following conditions also exist:

1. The overstory has a crown density of 10-50%.
2. One or more of the following treatment codes is indicated for the understory: 12, 20, 22, 30, or 33.

Code 15: Two storied stand (overstory, harvest - low risk; understory, manageable)

Two storied sawtimber stands meeting the requirements of treatment code 11, plus the following conditions, are assigned this code:

1. The overstory has a crown density of 10-50%.
2. One or more of the following treatment codes is indicated for the understory: 12, 20, 22, 30, or 33.

Code 20: Precommercial thinning

There are two general types of stands which qualify for precommercial thinning. These are:

1. Seedling and/or sapling stands which contain a manageable component of desirable or acceptable crop trees, but which will suffer growth loss from competition prior to reaching merchantable size, if stocking is not reduced.
2. Sapling to pole size Douglas-fir, western larch, ponderosa or lodgepole pine which meet all of the following characteristics:
 - a. Stand is currently growing at less than full potential because of competition.

- b. There is a fully stocked, manageable component which is capable of release.
- c. Thinning would not yield merchantable material, and would not involve the felling of near-merchantable trees.

Possible combinations: (13, 20), (13, 20, 23), (20, 23), (13, 20, 22, 23), (20, 22, 23), (13, 20, 22), (20, 22).

Code 21: Stand conversion

This treatment code automatically implies the need for regeneration, following conversion.

Stands which qualify for this category include all precommercial stands which have unmanageable insect or disease problems. Also included are non-vigorous precommercial stands which would not be capable of release, if thinned. In the case of lodgepole pine, it includes all non-vigorous stands which are older than 50 years.

Seedling and sapling stands which are grossly understocked with crop trees, but which contain a significant stocking of undesirable (excess) trees, are also included under this category.

Possible combinations: (13, 21).

Code 22: Sanitation

This code applies to all crop stands whose health can be improved through intermediate cuttings, i.e., cuttings which reduce the source of the insect or disease problem (not applicable for most defoliating insect problems).

This category does not include stands which are in need of commercial harvest or precommercial stand conversion because of insects or disease, low vigor, or stagnation. It applies only to stands which can be sanitized and managed as a crop stand.

Possible combinations: (13, 22, 33), (22, 33), (12, 13, 22), (12, 22), (13, 22), (13, 22, 23), (22, 23), (13, 20, 22), (20, 22), (13, 20, 22, 23), (20, 22, 23).

Code 23: Regeneration of understocked areas

Code 23 includes all precommercial stands which are inadequately stocked with desirable or acceptable crop trees. The minimum standard for adequate crop tree stocking is 210 trees per acre, with at least 70% of the area stocked.

This code by no means implies a particular method of regenerating understocked areas. Under code 23, options may exist for use of existing seed sources, site preparation, planting, direct seeding, or combinations of these methods. In many cases, this treatment code represents situations where the stocking of undesirable excess trees must be reduced prior to supplementing the existing understocked crop stand with additional regeneration. In such cases, this treatment would occur in combination with precommercial thinning (code 20).

It should also be noted that regeneration needs which are associated with stand conversion (code 21) are separate from those under code 23.

Possible combinations: (13, 22, 23), (22, 23), (13, 20, 23), (20, 23), (13, 20, 22, 23), (20, 22, 23), (13, 23).

Code 30: No treatment due to productive condition

Stands in this category are adequately stocked with productive crop trees, for timber management purposes. In the case of very young stands, stocking of undesirable (excess) competition is minimal, and should not impact growth rates on crop trees before merchantable size is attained. In the case of large sapling to small sawtimber stands, the crop trees are currently growing at or near full potential for their age and the site, and are expected to continue to do so for several years.

There are no significant insect or disease problems associated with stands in this category, with the possible exception of defoliators which have not affected the manageability of the stand.

Possible combinations: None

Code 32: No treatment - Inoperable

This category includes all stands on sites which are considered inoperable, using current, conventional Montana logging systems (balloon and helicopter systems are not considered conventional in Montana).

Generally, slopes steeper than 80% are considered inoperable at the present time. Other inoperable situations include very rocky areas, where road building and logging might be difficult, or an otherwise operable site which has no operable access routes.

This code is not assigned using the key, but is based on field observations.

Code 33: No treatment - Defer until merchantable

Code 33 includes poletimber to small sawtimber size stands of trees whose growth rates could be improved through thinning, but not without the loss of near-merchantable material. Because growth rates and tree quality are acceptable (but not optimal), stands in this category are deferred from treatment until the stand emerges into a size class where commercial treatment options exist. However, stands in this category may qualify for overstory removal (code 13) and/or sanitation (code 22), even though the crop stand has been deferred from thinning. In other words, the "No treatment" label applies only to the main stand component.

Possible combinations: (13, 22, 33), (22, 33), (13, 33).

Code 40: Unknown - Poor crowns, good growth

This is a fairly unique but well defined category for which the data compiled in the stand treatment analysis does not provide enough information to make a logical decision.

All stands under code 40 possess the following characteristics:

1. Fully stocked Douglas-fir, western larch, or ponderosa pine saplings, poles, or small sawtimber.
2. Growth rates at or near full potential.
3. Poor crown ratios (less than 30%).
4. No unmanageable insect or disease problems.

The problem in this situation is that the compiled data fails to explain why a stand would have poor crown ratios, but also good growth rates during the last ten (10) years. Have crowns recently become suppressed from competition? In this case, the next ten years' growth might be much lower. Or, has this stand been released during the last ten years? In this case, the crown ratios may be improving, even though they are presently unacceptable.

Because the data summary does not answer the above questions, the treatment opportunities are not logically defined for such a stand.

Possible combinations: None

APPENDIX 6. LOCATION RECORD SHEET AND TREE DATA SHEET

LOCATION RECORD SHEET

STATE		WORKING CIRCLE		LOCATION	
1	2	3	4	5	6
3	0	0	2	0	3
clean					

LOT 25 DEC 1978

LOCATION INFORMATION

REFERENCE POINT		COURSE TO SAMPLE LOCATION	
SP	202	AZ	179°
DBH	9.9	DIST.	312'
D. Fire sitting closest to fence east of fence corner.		WITNESS TREES	
		X SP202 DBH 14.1 AZ 178° DIST. 246.6'	
		Y SP202 DBH 6.1 AZ 108° DIST. 196'	
GENERAL STATEMENT		FIELD CREW	
Take right turn on to Hwy 284 off of Hwy 12 out of Townsend. Go 5.5 miles take Right turn on to Ray Creek Rd. Go 2.1 miles take left turn, Go 1.7 miles take Right Fork. Go 0.8 miles take Right Fork. Go 2.0 miles take left Fork. Go 2.4 miles stop truck and head south to corner of field - R.F. is across fence.		ESTIMATOR Metzmaker	
		RECORDER Long	
		PHOTOS	
		PROJECT AZT ROLL 3	
		PHOTO NOS. 73 + 74	
		FIELD EDIT	
		NAME otho	
		DATE 10/18/79	
		MONTH/DAY/YEAR	
		OFFICE EDIT	
		NAME K. Pearson	
		DATE 12/13/78	
		MONTH/DAY/YEAR	
		DECLINATION 0° B.A.F. 40	
USGS TOPO. MAP NAME Duck Creek Pass		TOWNSHIP 7N RANGE 3E SECTION 1	
MAP NO. 525			

STATE	12	WORKING	CIRCLE	34	LOCATION	5678
	30			03		0343

[illegible]

APPENDIX 7. FOREST LAND GRAZING DATA SHEET AND SAMPLE SCS GRAZING GUIDE

MONTANA
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DIVISION OF FORESTRY

WOODLAND RANGE FORAGE CONDITION RECORD

Location 109 Crew STEVE JORGENSEN - JEFF RUPKAWIS
County GRANITE Date 10/11/78
Working Circle 03 State Forest -

Species	Column A Present Percent Composition by Wt.	Column B Present Percent Composition Allowed
DECREASERS:		
EIK SEDGE	30	30
INCREASERS:		
PINE GRASS	35	15
MEADOW RUE	T	
OTHER FORBES	10	5
OREGON GRAPE	T	
SNOWBERRY	15	5
INVADERS: SPIREA	10	5
KENTUCKY BLUEGRASS	T	

Percent Composition 100% 60 %
Condition Class Rating XXXX Condition

Guide Sheet DOUG FIR CUMMAY Precipitation Zone -

Crown Density 10-30 30-50 50-70 70+
Soil Depth Deep and Moderately Deep (20") Shallow and Coarse
Very Shallow (10")

Greater Effective Moisture YES NO

REMARKS: AWO'S... 35 GRAZABILITY FACTOR - 33%

PART I. GUIDE FOR DETERMINING FORAGE CONDITION—15 to 19 INCH PRECIPITATION ZONE

DECREASERS	INCREASERS	Maximum Percent Dry Weight Produced Annually—Little or No Grazing						INVASERS
		Deep & Moderately Deep Soils (Over 20")			Shallow & Coarse Upland Soils			
		Tree Crown Cover Percent			Tree Crown Cover Percent			
		10-30	30-50	50-70	10-30	30-50	50-70	
Richardson's needlegrass	Pinegrass	5	10	20		5	10	All annuals
Blue wildrye	Prairie junegrass	5	-	-		5	-	Goatweed
Rough fescue	Idaho fescue	10	5	-		15	5	Cheatgrass brome
Columbia needlegrass	Carex Spp.	10	15	20		-	10	Spotted knapweed
Mountain brome	Heartleaf arnica	-	5	10		-	10	Dandelion
Nodding brome	Balsamroot	5	-	-		5	-	Kentucky bluegrass
Bluebunch wheatgrass	Lupine	5	-	-		5	-	Canada bluegrass
Bearded wheatgrass	Other forb increasers	10	15	15		5	10	Timothy
Western wheatgrass	Oregon grape	-	5	5		-	5	Thistles
Slender wheatgrass	Bearberry	-	5	5		-	5	Mullein
Sticky geranium	Other woody increasers	-	5	10		-	-	Leafy spurge
Stoneseed								Dalmation toadflax
Serviceberry								Houndstrongue
Snowberry								Star thistle
Huckleberry *								
Chokecherry								

Note: Tree Crown Coverage percent can be estimated from aerial photos using Crown Coverage Scale. (Handbook page W-132)
* Decreaser with game use.

Note: Tree Crown Coverage percent can be estimated from aerial photos using
Crown Coverage Scale. (Handbook page W-132)
* Decreaser with game use.

PART II. GUIDE FOR MAKING RECOMMENDATIONS ON STOCKING

Average Annual Precipitation Inches	PRESENT FORAGE VALUE IN PERCENT OF POTENTIAL											
	75%				50%				25%			
	EXCELLENT		GOOD		FAIR		POOR		POOR		POOR	
	Crown Cover Percent	10-30	30-50	50-70	Crown Cover Percent	10-30	30-50	50-70	Crown Cover Percent	10-30	30-50	50-70
25-29	.70	.45	.25	.60	.40	.25	.40	.25	.20	.10	.10	.10
20-24	.55	.30	.15	.45	.25	.15	.35	.20	.16	.15	.05	.05
15-19	.40	.20	.10	.35	.15	.10	.25	.15	.05	.10	.05	-
10-14	.25	.10	.05	.20	.10	.05	.10	.05	-	.05	0	-

Areas with above normal effective moisture use $\frac{1}{2}$ to 1 zone higher than precipitation zone where located.
For SHALLOW SOILS use values one half zone lower than precipitation zone where located.
For VERY SHALLOW SOILS use values one zone lower than precipitation zone where located.
All utilization cuts due to adverse accessibility are to be applied to grazing unit after AUM's are summarized.

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GLOSSARY

Acceptable tree

Growing-stock tree of commercial species that does not qualify as a desirable tree.

Access

The degree to which the range will be utilized. The factors affecting grazability are slope, miles to the nearest stream, trails and roads in the area, water developments, brush, slash, rocks and mechanical barriers.

Accretion

Annual increase in net volume of trees in a size class, and the increase in net volume of trees after reaching a measured size class during the year.

Allowable cut

The volume of timber that would be cut on commercial forest land during a given period under specified management plans for sustained production such as those in effect on national forests.

Animal Unit

One mature (1,000 pound) cow with or without an unweaned calf, or the equivalent. A mature bull is 1.3 animal units, a mature horse is 1.25 animal units, a mature sheep is 0.2 of an animal unit, a mature elk is 0.7 of an animal unit, and a mature deer is 0.2 of an animal unit.

Animal unit month

The amount of forage required by an animal unit for one month.

Area condition class

A classification of commercial forest land based upon stocking by desirable trees and other conditions affecting current and prospective timber growth.

Basal area

A measure of square feet of space occupied by the stem of a tree. This measurement is made at breast height.

Basal area factor

The basal or stem area per unit of stand area for a given angle for each tree intercepted from a given point.

Basal area standard

Sixty percent of normal basal area usually for trees 0.6 inches d.b.h. and larger.

Bureau of Land Management lands

Federal land administered by the USDI Bureau of Land Management.

Census water

Water areas of more than 40 acres and water courses more than 1/8 mile wide.

Climax series

A group of habitat types that at climax will be dominated by the same tree species.

Commercial species

Tree species presently or prospectively suitable for industrial wood products.

Commercial thinning

A thinning in which the cut trees are large enough to be removed and utilized, regardless of whether their sale offsets the cost of the thinning.

Commercial timberland

Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. (Note: Areas qualifying as productive forest land have the capability of producing in excess of 20 ft³/acre/year of industrial wood under management. Currently inaccessible and inoperable areas are included, except where the areas involved are small and unlikely to become suitable for production of industrial wood in the foreseeable future).

Condition class

A method of expressing the general health of the range by comparing the expected percentage of the climax composition contributed by each species to the actual composition. No invaders (plants present only because of a disturbance, such as grazing) are counted and only the amount of increasers (plants that increase under grazing pressure) that would be present at climax are included. All of the decreasers (plants that decrease under grazing pressure) are counted.

County and municipal lands

Lands owned by counties and local public agencies or municipalities, or lands leased to these governmental units for 50 years or more.

Crown class

A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of light received from above and the sides.

Crown density

The percentage of the forest floor that is covered by tree crowns. Forest land with greater than 70% crown density is considered to have no range value for livestock.

Cull

Portions of a tree that are unusable for industrial wood products because of rot, form, or other defect.

Decreaser (decreasing range plant)

Plants which decrease under heavy grazing pressure. These are usually the more palatable plants and the ones that the livestock prefer to eat.

Diameter breast height (d.b.h.)

The diameter of a tree at a point $4\frac{1}{2}$ feet above the ground on the tree's uphill side. Height of d.b.h. may vary on abnormally formed trees.

Desirable tree

Live noncull trees of commercial species are divided into two classes: desirable and acceptable. For a tree to be desirable it must be free from disease, of good form, potentially not more than 10 percent defect of disease or fire scar, of good vigor, and not excessively limby if saw-timber. A tree will be considered to have good vigor if it has 40 percent or more crown (exception: ponderosa pine, and aspen may have only 30 percent crown to be classed as desirable). It is the kind of tree that would be favored in cultural operations or featured in management in under rotation-age stands. Mature trees (over rotation age) of commercial size with less than 20 percent defect and expected to live 10 years are low-risk trees and may also be classed as desirable trees. A species which is not adapted to the site should be classified as sound cull.

Diameter Classes

A classification of trees based on diameter outside bark, measured at breast height ($4\frac{1}{2}$ feet above the ground). Note: D.b.h.. is the common abbreviation for diameter at breast height. Two-inch diameter classes are commonly used in Forest Survey, with the even inch of the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h., inclusive).

Farmer-rancher lands

Lands owned by individuals with a minimum of 40 acres.

Fixed radius plot

For this inventory a $1/300$ acre (6.8 feet radius), circular plot, located at each sample point on which live trees up to 4.99 inches d.b.h. are tallied.

Forest industry

Lands owned by companies or individuals operating wood-using plants.

Forest land

Land at least 16.7 percent stocked by forest trees, or formerly having such tree cover, and not currently developed for nonforest use. Forest land does not include land currently developed for nonforest uses such as urban or thickly settled residential or resort areas, city parks, orchards, improved roads, or pasture lands improved by such measures as seeding or irrigation. The minimum area for classification of forest land is one acre. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads, trails, streams, and clearings in forest areas are classed as forest land if they are less than 120 feet wide.

Forest types

A classification of forest land based upon the dominant species forming a plurality of stocking based on area occupied in the present tree cover.

Fish, Wildlife, and Park Land

Land administered by the Montana Department of Fish, Wildlife, and Parks.

Grazability

The degree to which the range will be utilized. The factors affecting grazability are slope, miles to the nearest stream, trails and roads in the area, water developments, brush, slash, rocks and mechanical barriers.

Gross growth

Annual increase in net volume of trees in the absence of cutting and mortality. It includes ingrowth and accretion.

Growing-stock trees

Live trees of commercial species qualifying as desirable or acceptable trees. (Excludes rough, rotten, and dead trees.)

Growing stock volume

Net volume in cubic feet of live sawtimber trees and live poletimber trees (all trees 5.0 inches d.b.h. and larger) from stump to a minimum 4.0 inch top (of central stem) outside bark. Net volume equals gross volume less deduction for rot and missing bole sections.

Habitat type

An aggregation of all land areas potentially capable of producing similar plant communities at climax.

Hardwoods

Dicotyledonous trees, usually board-leaved and deciduous.

Increaser (increasing range plant)

Plants which increase under heavy grazing pressure. These are usually less palatable plants.

Indian lands

Tribal lands held in fee by the Federal Government, but administered for Indian tribal groups and Indian trust allotments.

Ingrowth

The number or net volume of trees that grow large enough in diameter during a specified year to qualify as saplings, pole timber, or sawtimber.

Inoperable stand

Any stand on a site that is considered inoperable using current, conventional Montana logging systems (balloon and helicopter systems are not considered conventional in Montana). A more detailed explanation is given under treatment code 32 in Appendix 5.

Invader (invading range plant)

Plants that are not part of the climax cover but which invade under heavy grazing pressure. Few invaders are preferred by livestock and many are worthless.

Land use influence zones

Zones delineated around areas or regions where it is likely that other nontimber uses or environmental constraints would have an impact on availability of timber.

Mean annual increment

A measure of the volume of wood, in cubic feet, produced on 1 acre during 1 year. Forest Survey minimum standard for commercial forest land is the ability to produce 20 ft³/acre/year.

Miscellaneous federal

Federal lands other than national forest lands, lands administered by the USDI Bureau of Land Management, or Indian lands.

Mortality

Number of sound-wood volume of growing stock trees dying from natural causes during a specified period.

Mortality tree

A tree of commercial species, 5.0 inches d.b.h., or larger standing or down, that has died within the past 5 years and was not a cull tree at the time of death.

National forest land

Federal lands which have been designated by executive order or statute as national forests or purchase units and other lands under the administration of the USDA Forest Service, including experimental areas.

Net annual growth

The increase in net volume of a specified size class for a specific year. (Note: Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to its end, plus net volume of trees reaching the size class during the year, minus the net volume of trees that died during the year, minus the net volume of trees that became rough or rotten trees during the year). Net growth figures in this in this publication when expressed as ft³/acre/year of growing stock are for all live growing stock trees 5.0 inches d.b.h. and larger.

Net volume

The gross volume of a tree less deductions for rot, sweep, or other defect affecting use for wood products.

Noncommercial forest land

Forest land incapable of producing 20 cubic feet per acre of industrial wood under management, because of adverse site conditions, includes only nonreserved forest land.

Noncommercial species

Tree species of typically small size, poor form, or inferior quality which normally do not develop into trees suitable for industrial wood products.

Nonforest land

Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. It includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, power-line clearings of any width and 1 to 40 acres of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., more than 1 acre in size to qualify as nonforest land.

Nonsalvable dead

Dead trees 5.0 inches d.b.h. and larger, standing and down, and less than 50 percent sound on a cubic-foot basis.

Firm rotten: Tree is less than 50 percent sound on a cubic-foot basis. More than half the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections are firm enough to hold together if handled.

Crumbly rotten: Tree is less than 50 percent sound on a cubic-foot basis. More than half the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections will not hold together if handled.

Nonstockable

Areas of forest land not capable of supporting seedlings of commercial species because of the presence of rock, water, roads, etc.

Nonstocked land

Commercial forest land less than 16.7 percent stocked with growing stock trees.

Normal basal area

The basal area at which all growing space is effectively occupied but having ample room for development of the crop trees.

Old-growth sawtimber stands

Sawtimber stands in which 50 percent or more of the area is occupied by old-growth sawtimber trees.

Other forest land

See noncommercial forest land

Other private ownership group

The ownership group that consists of land owned by farmers, ranchers, miscellaneous private corporations, and miscellaneous private individuals.

Other private corporate

Land owned by corporations not in the forest industry.

Other private individual

Lands smaller than 40 acres owned by individuals.

Other state lands

State land other than state forests, land board, and Fish, Wildlife, and Parks.

Ownership class

The finest level of ownership used in this report. The classes are: miscellaneous federal, Department of State Lands-Classified Forest Land and Classified Grazing Land, county and municipal, Montana Department of Fish, Wildlife and Parks, other state, forest industry, farmer-rancher, other private corporate, and other private individual.

Ownership group

Convenient groups of ownership classes. The groups are: State and other public, forest industry, and other private.

Poletimber stands

Stands at least 16.7 percent stocked with growing stock trees of which 50 percent or more of this stocking is in pole timber and/or sawtimber trees, and with pole timber stocking exceeding that of sawtimber.

Pole timber trees

Trees at least 5.0 inches in diameter at breast height but smaller than 9.0 inches for softwoods and 11.0 inches for hardwoods.

Potential growth

Or yield capability is defined as mean annual increment of growing stock attainable in fully stocked natural stands at the age of culmination of mean annual increment. When expressed in cubic feet of growing stock, unless specified otherwise, the volume figure includes all surviving live trees 1.0 inches d.b.h. and larger, for most tree species. See Brickell (1970) for further information.

Precommercial thinning

A thinning in which the cut trees are too small to be removed and utilized.

Productive-reserved forest land

Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas-tree production.

Rotation

The period of years between establishment of a stand of timber and the time when it is considered ready for cutting regeneration.

Rotten trees

Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet long or longer, now or prospectively and/or do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees

- (1) Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet long or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of roughness or poor form.
- (2) All live trees of noncommercial species.

Salvable dead

Standing and down dead trees 5.0 inches d.b.h. and larger and more than 50 percent sound on a cubic foot basis.

No defect: Tree has no rot, and no defect such as excessive sweep and crook.

Defect-mostly physical: Tree is more than 50 percent sound on a cubic-foot basis. Less than half the total volume loss is due to rot and more than half is due to such defects as excessive sweep and crook.

Defect-mostly rot: Tree is more than 50 percent sound on a cubic-foot basis. More than half of the total volume loss is due to rot and less than half is due to such defects as excessive sweep and crook. Tree or potential product sections are firm enough to hold together if handled.

Sanitation

Improving the health of a stand through intermediate cuttings which reduce the source of the insect or disease problem.

Saplings

Trees 1.0 inches to 4.0 inches in diameter at breast height.

Sawlog

A section of a tree stem of sufficient size to yield commercial size dimension lumber.

Sawtimber trees

Softwood trees which are 9.0 inches and larger and hardwood trees which are 11.0 inches and larger in diameter at breast height.

Sawtimber volume

Net volume in board feet of sawtimber trees of commercial species. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner Rule

The common board-foot log rule used in determining volume of sawtimber in the Western states.

Seedlings

Live trees less than 1.0 inch in diameter at breast height.

Seedling-sapling stands

Stands at least 16.7 percent stocked with growing stock trees in which more than half of the stocking is saplings and/or seedlings.

Site Class

A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Site classifications are based upon the mean annual growth of growing stock (not including thinnings) attainable in fully stocked stands at culmination of mean annual growth. Height-age relationships are usually used as indicators of the specified volume-site class.

Site index class

A measure of site productivity based upon the height of trees at a given base age. Site index classes are height classes represented by a graphed curve of height over age for each class.

Site trees

Trees measured for height and age, used to estimate site index.

Softwoods

Coniferous trees, usually evergreen, having needle or scale-like leaves.

Stand density

A quantitative measure of a stand in terms of square feet of basal area, number of trees, or volume per acre. It reflects the degree of crowding of stems within the area.

Stand-size class

A classification of forest land based on the class of growing stock trees on the area, that is, sawtimber, pole timber, or seedlings and saplings. (Note: Only those trees that contribute to no more than 16 percent of stocking at a plot point, based upon a 10-point location, will be considered in determining stand-size class).

State and other public ownership group

The ownership group that consists of state, county, municipal, and miscellaneous federal land.

State forest

Lands administered by the Department of State Lands that are managed as a unit.

State forest land

State owned land that is principally valuable for forest and watershed cover that is classified as forest and administered by the Department of State Lands.

State grazing land

State owned land that is principally valuable for forage production that is classified as grazing and administered by the Department of State Lands.

Stocking

Stocking is an effort to express the extent to which growing space is effectively utilized by present or potential growing-stock trees or commercial species. "Percent of stocking" is synonymous with "percentage of growing space occupied" and means the ratio of actual stocking to full

stocking for comparable sites and stands. Basal area is used as a basis for measuring stocking.

"Stocking percentages" express current area occupancy in relation to specified standards for full stocking based on number, size, and spacing of trees considered necessary to fully utilize the forest land.

Full utilization of the site is assumed to occur over a range of basal area. As an interim guide, 60 percent of the normal yield table values has been used to establish the lower limit of this range which represents full site occupancy. This is called 100-percent stocking. The upper limit of full stocking has been set at 133 percent. Sites with less than 100-percent stocking represent under-stocking with less than full site occupancy. Over-stocking is characterized by sites that have over 133 percent stocking.

Tertiary deposits

Rock and materials deposited in the period of geologic time previous to the current period, which ran from about 65 million to about 2.5 million years ago.

Tree class

A classification assigned to each live tree based on such physical characteristics as surface and internal defects, crown ratio, crown class, and damage sustained by the tree. (See also desirable tree, acceptable tree, rough tree, and rotten tree).

Tree size class

A classification of trees primarily according to diameter at breast height outside bark, including sawtimber trees, pole timber trees, saplings, and seedlings.

Unproductive forest land

Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions, because of adverse site conditions.

(Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness).

Variable radius plot

A plot on which a predetermined critical angle is projected from a central point, and swept in a full circle, to determine the basal area, tree count, and volume per unit of area. The radius of this plot is a function of tree basal area and is therefore variable.

Young-growth sawtimber stands

Sawtimber stands in which 50 percent or more of the stand is occupied by young-growth sawtimber trees.

Young-growth sawtimber trees

Sawtimber trees less than 100 years old.

MONTANA
DEPARTMENT OF STATE LANDS
DIVISION OF FORESTRY
MISSOULA, MONTANA



700 copies of this public document were published at an estimated cost of \$7.28 per copy, for a total cost of \$5,100.00, which includes \$5,100.00 for printing and \$.00 for distribution.